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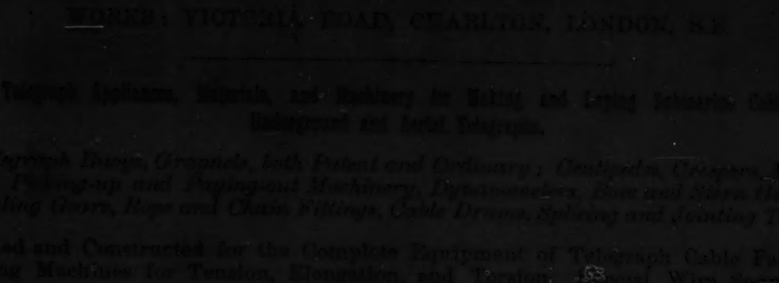

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ELECTRIC LIGHTING PROVISIONAL ORDERS BILLS.

ON Saturday last these Bills were under the consideration of a Select Committee of the House of Lords, presided over by the Duke of Buckingham. Of the 23 Provisional Orders for lighting the area comprised within the jurisdiction of the Metropolitan Board of Works only five were set down as opposed—namely, those relating to Finchley, Poplar, and Hackney, and the two Orders for lighting the parishes of St. James, Westminster, St. Martin's-in-the-Fields and the Strand district. On the assembling of the Committee it was announced that, all opposition having been withdrawn from the Finchley, Poplar, and Hackney Orders, no evidence would be offered upon them, and accordingly they passed unopposed. The Committee thereupon proceeded to consider the two Orders for lighting the parishes of St. James, St. Martin's and the Strand district, both of which were opposed, as in the House of Commons, by the Strand District Board of Works and the Jablochkoff Electric Lighting Company. The Board of Trade was represented by Mr. Meysey-Thompson. Mr. Pope, Q.C., and Mr. Moulton were for the Swan and Edison Companies; Mr. Pember, Q.C., and Mr. Jeune were for the Strand district and the Jablochkoff Company respectively; and Mr. Cripps (Dyson and Co.) for the inhabitants of the district.

Mr. T. H. Farrer, permanent secretary of the Board of Trade, was the first witness called. He said he appeared simply to state what had been the action of the Board under the Act of last Session, and not as the promoter or opponent of any of the schemes. The Electric Lighting Act gave the means of obtaining power to promoters and to local authorities to spend their money for electric lighting if they wished to do so. The Act provided two methods—one a licence to be obtained with the consent of the local authority, which was the lighting authority of the district, and to be granted by the Board of Trade, but without appeal to Parliament; that licence could last for seven years only, but was capable of renewal. The other mode was by provisional order, and that could be granted by the Board of Trade, without the consent of the local authority. The Committee on the Electric Lighting Bill did not submit anything as to price, but they inserted a clause enabling a local authority, after the expiration of 21 years, to purchase the concern at the cost of the then plant considered as the plant of a going concern, but without any additional price for compulsory purchase or goodwill. This was in order to prevent the evils of perpetual monopoly as in the case of water and gas. It gave the Board of Trade large powers of inserting conditions in favour of the public, in respect of supply and safety, and various other things. The Board of Trade made it a rule immediately the Act came into operation to give the preference to the local authority where a local authority and a company were in competition, and it was the principle of the Board of Trade to consult the local authority on such matters as area, price, and so on. A very large number of applications were received at the Board of Trade, both as regarded the metropolis and the country last autumn, and they gave rise to long consultations between the Board of Trade and the various local authorities. Finally a model order was framed and was circulated in the spring to the various local authorities and companies, and upon that order the subsequent provisional orders were framed. It was thought by the Board of Trade that the private lighting was by far the most important part of the concern. The orders granted did not create a monopoly, because if the concern proved profitable at the end of 21 years it might be bought up. In the meantime those persons who had got the order would have a priority. The price of electricity was at present unknown; it depended upon science and also on the demand for it. If it should turn out that those companies who had got the order at a higher price in other parts of England or the metropolis, who adopted better means, or who had other means of supplying at a lower price, there was nothing to prevent the Board of Trade or Parliament introducing a new company even into those districts, and the Board of Trade wished in the first place to introduce a clause to that effect. It was found, however, that any clause that could be introduced limited this power instead of giving it, and therefore, the Board of Trade had in their circulars to their promoters indicated in every possible way that they would hold themselves perfectly free to introduce competition if it should prove that those parties were not supplying the public at a reasonable price having regard to the state of science.

The Chairman: I want to know whether the Board of Trade has power to introduce a competing scheme?

The witness replied that under the Electric Lighting Act of last session the Board of Trade could only grant powers to break up streets within the area of supply; and in the Strand district, for example, they could not grant powers over one part of the Strand district to another part of the Strand district. Then with regard to the price, as he had already stated, no one knew what electricity could be supplied at; but the Board of Trade did not consider that the *maximum* price was a very important consideration. It was clear that electricity would come into competition with gas, and the price of gas was being gradually reduced, and if the gas companies were pressed by the electric companies they would reduce the price of gas still more. The gas companies had scope for large reductions if pressed by competition, and for many years the competition would be very severe, and it would be to the interest of the electric companies to drive the gas out altogether.

Mr. Pope, Q.C., for the Swan and Edison Companies, strongly urged that the Jablochkoff Company were unable to supply electricity for domestic purposes without the entire alteration of their system, however good it might be for street lighting. He subsequently made an offer to give up the whole of the public lighting if so desired by the local authorities.

Mr. Pember, Q.C., on behalf of the Jablochkoff Company, refused this offer.

Sir Frederick Bramwell gave evidence in favour of the capabilities of the Edison Company, and stated that he believed it fully able to carry out the lighting, as proposed.

Sir John Lubbock, M.P., was called, and stated that he was the chairman of the Edison Electric Lighting Company, and that that company was quite prepared to spend £80,000 on the necessary works, which were to be completed within the two years limited by the order. In answer to the question whether his company would be prepared to expend that amount with the seven years' licence, as proposed by the Jablochkoff Company, he said that of course they would require additional price for the light so as to recoup themselves for the shorter period, and that would not be in the interest of the consumer.

Mr. Pember, Q.C., addressed the Committee for the Jablochkoff Company, and pointed out that that company was just as competent to supply electricity in any form as the Swan and Edison Companies, they were not limited to what was known as the Jablochkoff system.

Mr. Cripps, of the firm of Dysòn and Co., gave evidence as to the position of the Strand District Board of Works. He pointed out that these electric lighting Bills had been hurried through Parliament, and had really not given the legal authorities time to consider them.

The Committee then adjourned, and again met on Tuesday, when

Mr. Jones, the Chairman of the Electric Lighting Committee of the Strand District Board of Works, stated that the Board preferred that a licence should be granted to the Jablochkoff Company, because of the shorter time involved than in the case of a provisional order.

By the Committee: They objected to the fixing of a price for twenty-one years, considering the state of change in which electricity was. Negotiations with the promoters for a revision of prices at the end of ten years had failed.

Mr. Pember, Q.C., here addressed the Committee on behalf of the Strand District Board of Works.

The Chairman said the Committee desired to know generally the views of the Board of Trade with regard to the question of the powers conferred upon them by the Electric Lighting Act, especially as regarded the granting of licences over a large area, and which would involve the outlay of a large amount of capital. He would therefore ask Mr. Calcraft—first, whether the Board of Trade had had any other, and what, applications for licences.

Mr. Calcraft (Assistant-Secretary to the Board of Trade) answered that there had been 10 applications, but he could not say whether any of those were over large areas, as the Board of Trade had not at present entered into any of the details connected with licences, but he might state that they had consented to the general principle of the Act. The time was now approaching when it would be necessary to decide what principle must guide the Board of Trade with regard to these licences, and they had decided that they would not be prepared to grant any licences for large and important districts involving a considerable outlay of capital; and one of the principal reasons which influenced them in coming to that decision was, that in important cases Parliament should have the direct responsibility of authorising an undertaking, imposing such restrictions as they might think fit. As yet, no licences had been granted, and the applications would not be considered by the Board of Trade until October. The difference in price between certain systems was attributable to the fact that in some cases the installation was more expensive than in others.

The Chairman: Have the Board of Trade under the Act of Parliament power to refuse any licence?

Mr. Calcraft: Certainly. The procedure with regard to the application was this: The local authority must consent; then the Board of Trade had to decide whether they would entertain the application; then the necessary notices were given, and three months after that the decision was given; two months were allowed for parties to lodge objections.

Mr. Pope, Q.C., having addressed the Committee in reply, the room was cleared, and after an interval of a quarter of an hour,

The Chairman announced that the Committee had decided to approve of both Orders, with a proviso that "nothing in the Orders was to exempt the undertakers from the provisions of any future general Act which might be passed relating to the supply of, or the price to be charged for electricity."

Mr. Jeune said they had been taken by surprise at the evidence of Mr. Calcraft on behalf of the Board of Trade, and, therefore, he asked that there should be a suspensory clause inserted in the Bill to enable the Jablochkoff Company to bring in a special Act as provided for by the Act.

Mr. Pope: You still have the power of bringing in a Bill.

The Chairman: The Committee will not put in a suspensory clause.

The matter then dropped.

ELECTRO-MOTORS AND THEIR GOVERNMENT.*

By Professors W. E. AYRTON, F.R.S., and JOHN PERRY, M.E.

THE near approach of electric mains being laid under our streets, and the facilities they will offer for supplying electric power during the day time to factories, workshops, and even to private houses for domestic purposes, lends an immediate importance to considerations regarding the best form that should be given to electro-motors, as well as to the best conditions under which they should be used; while the comparatively novel question as to the methods that can be employed for governing motors, so as to make them run at the same speed whatever work they may be doing, is of equally pressing importance, seeing that this condition of constant speed must necessarily be fulfilled before we can expect to see lathes, circular saws, and other tools in our workshops regularly driven by electro-motors.

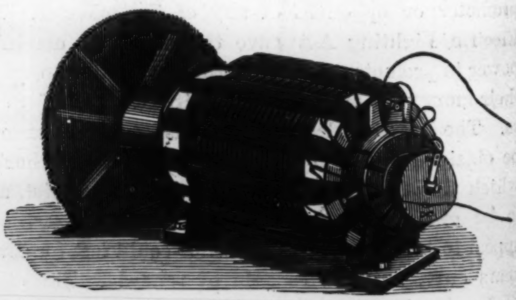

FIG. 1.

The great value of electro-motors arises—

1st, from their portability, seeing that they need only be connected by means of a pair of thin flexible wires with the main supply cables.

2nd, from their small weight per horse-power developed by them.

3rd, from the possibility of their being used at a considerable distance from the prime mover.

4th, from their working to the best advantage when run fast, and so being especially suitable for driving quick-moving machinery direct, without any intermediate gearing; for in a factory there is a great loss of power arising from the friction of a long line of shafting turning in its bearings, and, secondly, there is a loss of power in the intermediate gearing employed to make the drill on other quick-moving tool revolve much more rapidly than the shaft.

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* Read before the Soc. Tel. Eng. and Electricians.

The portability of motors enables us to bring the machine-driven tool to the work, instead of, as at present, the work to the tool. For example, fig. 1 shows a circular saw directly driven by one of our motors, and which can be moved about with tolerable convenience. Again, fig. 2 shows an emery wheel also driven by one of our motors, and which can be moved about for the purpose of polishing any large piece of metal.

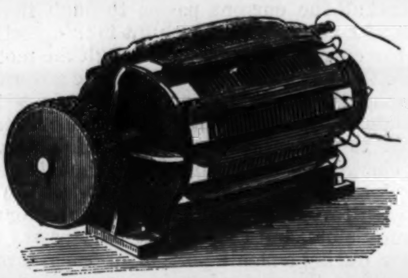


Fig. 2.

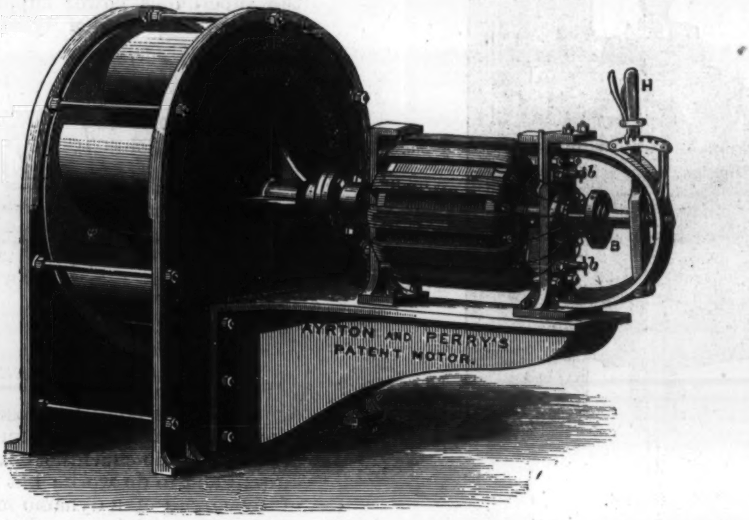

H
b
B
b
AYRTON AND PERRY'S PATENT MOTOR.

Fig. 3.

The third and fourth advantages make electro-motors of especial importance to us Londoners at this present moment.

The unsightly blow-holes on the Thames Embankment and at this end of Victoria Street have now fallen out of favour, if they ever were in favour. Although English people are not supposed to be strong in matters of taste, we still cannot contemplate with equanimity a series of low chimneys, emitting foul gases, scattered along our principal thoroughfares, especially when perfect ventilation can be obtained by fans directly driven by motors. Such a fan, kindly placed at our disposal by the Rev. Mr. Capell, is shown in fig. 3, three feet in diameter, which is now passing 16,000 cubic feet per minute at 1,000 revolutions, and is driven by one of our motors, the electricity being supplied by Faure-Sellon-Volckmar accumulators, kindly lent us by the Electrical Power Storage Company. These fans might be stationed along the tunnel, each driven directly by a motor without intermediate gearing. A single going and return insulated wire would convey an amount of power which seems incredible to a mechanical engineer; and a steam-engine doing the work, as well as a dynamo machine supplying the electricity, might be all in some backyard, out of everybody's way. The gas might be sent into the water of the Thames, and, if even the bubbling up of the gas was thought objectionable, it might bubble up in the recesses in the walls, so that the bubbles could not be seen. The particular specimen of our electro-motors which we are employing this evening has adjustable lead and reversing gear: this of course would not be necessary for motors permanently fitted and always run at a fixed speed, but it is very handy for motors when used experimentally. The details of the reversing gear can be seen from figures which come later on in this paper, where a description of the gearing will be found.

The smaller 2-foot fan, which is being driven also by one of our motors, is passing about half the quantity of air.

The portability of electro-motors and their light weight make them of enormous importance where locomotion is involved. It may be in the memory of some of those present that a year ago we advocated the automatic electric transport of goods and passengers by means of electric railways without engine-driver, guard, or signalman, and we showed experimentally that the idea was perfectly feasibly when our absolute block-system was employed. This idea has borne fruit, for Professor Fleeming Jenkin, with his usual enthusiasm, was fired with it, and our conjoint ideas have led to what is known as "telpherage." "Telepherage" the Greek scholars among you will no doubt consider better, but in these days of speed and brevity, when the words "ergs," "volts," and "ohms" are tolerated, the abbreviation of "telepherage" to "telpherage" will doubtless be pardoned. We may mention that telpherage experiments on a working scale are on the eve of being tried, so that we hope that "to telpher" will shortly be a common English expression.

For telpherage, and indeed for motor work generally, it became of immense importance to know what horse-power per pound dead weight of motor could be practically obtained, what efficiency could be relied on, and how a motor could be best governed that is always made to go at the same speed whatever work it was doing. We have therefore been engaged on a long series of experiments on motors of different sizes, but before giving an account of the result of these experiments we will consider theoretically the general principles involved in the government of motors, and exhibit one of our motors which is governed without using anything of the nature of a mechanical governor.

Governing.

A motor may be governed to run at the same speed whatever work it may be doing, in one or other of two distinct ways. First, the power may be cut off in proportion as the work is cut off; or, second, a brake may be employed to replace the useful load removed, which brake may either waste the excess power or store it up for future use. Hitherto the first method alone has been attempted, viz., that of cutting off the power, and usually with this very serious defect, that instead of the power cut off being directly in proportion to the work cut off, the arrangements have been such that either all power was cut off or none, so that the motion of the motor was spasmodic, just as in an ordinary gas-engine, which suffers from the same defects, that full charge of gas or no charge are the usual only alternatives. A sample of an electro-motor governor of this type, and which may be called a "spasmodic governor," is shown (fig. 4), and consists merely of a rotating mercury cup into which dips a wire, which makes in this case contact with the mercury, and so completes the circuit when the speed is slow, but which, on account of the hyperbolic form assumed by the surface of the mercury as the speed rises, ceases to dip into the mercury at high speeds, and so breaks contact. This governor, you observe, is very erratic in its action, yet it will be found among the modern specifications at the Patent Office.

The first improvement we made in governing consisted in replacing the "spasmodic governor" by a "periodic governor." With our "periodic governor" the power is never cut off entirely for any length of time; nor, on the other hand, is full power ever put on for any length of time, but in every revolution power is supplied during a portion of the revolution, the proportion of the time in every revolution during which much power is supplied to the time during which less is supplied depending on the amount of work the motor is doing. Our periodic governor, then, differs from the spasmodic governor in the same way that a good loaded steam-engine governor differs from the ordinary governor of a gas-engine. One of the ways of effecting this result is as follows:—A brush, A, fig. 5, lies on the rotating-piece, B, K, the cylindric surface of which is formed of two conducting portions connected with one another through any resistance, and the brush, A, is moved along the cylinder, B, K, under the action of the governor balls. When the brush, A, is touching the contact part, B, the motor is receiving current directly; but when A rests on the part, K, the motor receives current through the resistance which is interposed between B and K. If the governor balls fly out, the brush is moved along B, K, so that there is contact with K during a greater part of the revolution than before; and if the governor balls come together, the speed of the motor being too small, the brush is moved in the opposite direction, so that it makes contact with B for a longer time during each revolution.

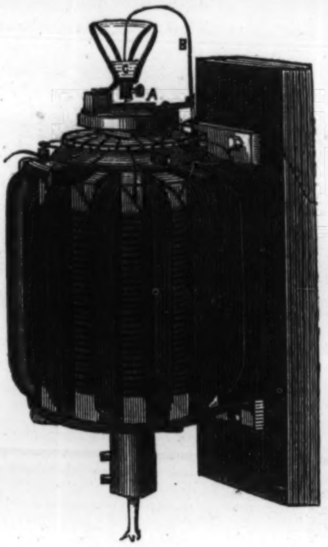


FIG. 4.

If the motors are in series, we arrange that the periodic governor shunts the currents periodically, instead of introducing resistance. In this case the connections are as follows:—

B is made of wood, while K is made of metal. K is connected to one end of a shunt coil, the other end of the shunt being connected to one of the terminals of the motor, and A is connected to the other terminal of the motor. If, then, A rests on B, the shunt is inoperative, and all the current passes through the motor; whereas, if A rests on K, the shunt is in operation, and part of the current only passes through the motor.

We are fitting up one of our periodic governors to a Gramme machine working as a motor in series with accumulators—that is to say, a dynamo machine is employed to work the Gramme machine as a motor, and to charge the accumulators. When the motor is running too fast, all the current is, during the greater part of each revolution, shunted past the motor through the accumulators, and the current only passes through the motor during a small portion of each revolution; whereas, when the motor is going more slowly, all the current passes through the motor during the greater part of each revolution before passing through the accumulators.

It is difficult with any such governors to entirely prevent sparking, and hence we prefer a totally different form of governor that we have devised, depending on the second system referred to above—that is to say the employment of a brake, which brake stores up the superfluous power supplied to the motor. It is well known that if a dynamo machine be running empty, and its poles be closed, a great backward pull is exerted on the driving mechanism, in consequence of the dynamo machine now commencing to send a current and to do work; but not only will the closing of the circuit of a dynamo machine cause a pull to be put on the driving mechanism, but even a slight increase in the speed of a dynamo, the circuit of which remains unaltered, will also produce the same effect if the speed be the critical speed for the resistance through which the dynamo is sending a current, because this critical speed is that below which but a small current is sent by the dynamo machine, and above which a great current is sent by the dynamo machine—that is to say, below the critical speed for any particular resistance the dynamo acts very feebly, while above that speed it acts as a powerful dynamo machine. Such a dynamo machine, then, with closed circuit, attached to the motor and driven by it, would act as a brake, and if the normal speed of the motor was the critical speed of the dynamo for the particular resistance in its circuit, it would act as a very efficient brake, causing a great opposition to even a small increase of speed beyond that at which it was desired the motor should run at.

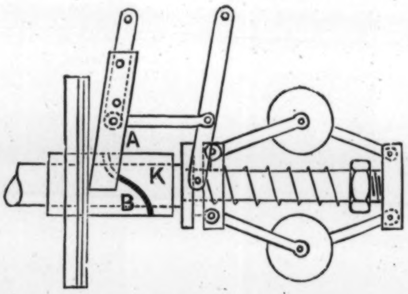
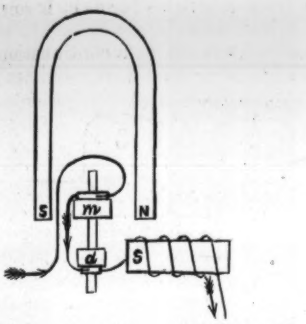


FIG. 5.

Hitherto we have spoken of the dynamo brake as if the electric power produced by it were wasted, but if it be in the same circuit as the motor, then the electric power produced by its rotation will help on the current, and the energy it absorbs in acting as a brake will not be subtracted from the energy of the whole system, but will merely diminish the speed of the particular motor in question. Fig. 6 shows such an arrangement, in which a magneto-motor is geared with a small series dynamo—that is to say, the same spindles carries the armatures of both machines. The current passes through both the armatures in series, and then through the field magnet of the motor. In consequence of its passing through the armature, *m*, of the motor, the spindle is rotated, and a back electromotive force is set up, resisting the current, whereas the motion of the armature, *d*, of the dynamo sets up a forward electromotive force, and assists the current.

This combination of motor and generator brake is the gist of our method, and the exact combination we employ in any particular case depends on what are the supply conditions—that is to say, whether constant difference of potential is kept up at the terminals of the motor, or constant current is passing through the motors. When motors and lamps are in parallel circuit, then, in order that any one of them shall operate independently of all the others, it is necessary that constant difference of potentials shall be maintained between the supply leads; whereas, if they are in series, it is the current that must be kept constant to make the one apparatus which is consuming the electric energy independent in its action of the remainder. We have elsewhere described in detail the various methods we employ for obtaining constancy in the supply conditions in each of these two cases, and we shall assume in this question of governing motors that one or other of these supply conditions is kept constant.



FIGS. 6,

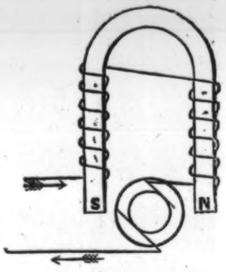


FIG. 7.

1st. *When constant potential difference is maintained between the main supply leads.*

Fig. 6 is one of the arrangements that might be employed for governing the motor, and, although suitable enough for stationary motors, would have the disadvantage, if the motor had to be used for locomotion, that it contained two distinct machines. In practice, then, we prefer to replace the arrangement shown in fig. 6 by that shown in fig. 7 or 8.

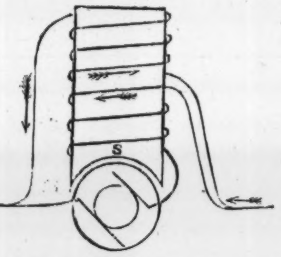


FIG. 8

In Fig. 7 we have a magneto-motor, but, in addition, the wire forming part of the main circuit is coiled round the limbs of the permanent magnet in such a direction that the current passing through it weakens this permanent magnet. The result is that the armature and permanent magnet alone form a motor, whereas the armature and the coils of wire wound round the permanent magnet form a brake-dynamo. The current passing through the armature, acted on by the permanent magnet, produces motion, and hence is resisted, while the current passing through the armature and through the coils wound round the permanent magnet resists motion, and hence is assisted.

Fig. 8 differs only from Fig. 7 in that the permanent magnet is replaced by a shunt circuit, which it is easy to see it is possible to do if it be remembered that the supply condition we are dealing with is "constant difference of potentials at the terminals of the motor;" hence the current which passes through the shunt circuit will be a constant current, and the iron of the field-magnet, as far as this circuit is concerned, will act as a permanent magnet. The current then passing through the shunt circuit magnetises the field-magnet, as shown in the figure, but, in addition, the wire which forms part of the armature is wound round this field-magnet in such a way that the current passing through it tends to demagnetise the field-magnet, and here, as before, the armature and shunt circuit act as a motor, while the armature and the thick wire coil, which is a continuation of the armature, and which is wrapped round the field-magnet, form a brake-dynamo.

So far we have been dealing with motors in parallel circuit, with constant difference of potentials at their terminals. We will proceed to consider motors in series, and in that case the supply conditions will be—

2nd. *Constant current passing through all the motors.*

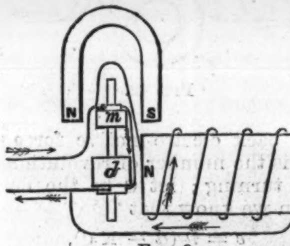


FIG. 9.

Here we may also combine two armatures working on a common spindle, as shown in Fig. 9, but in this case the magneto machine is a brake-generator, while the motor, which is the larger, is a shunt motor, the field-magnet being a shunt to both armatures, which latter are in series.

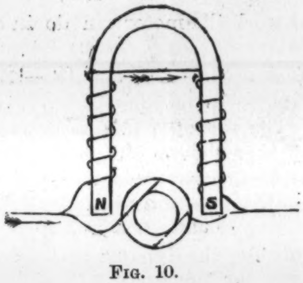


FIG. 10.

This double machine may be replaced by a coiled magneto-machine, as in Fig. 10, in which we have a magneto-generator, acting as a brake, and a shunt motor. Or, again, this may be replaced by the arrangement in Fig. 11, where the fine wire coil, which is a shunt to the armature only, acts with the armature as a motor; and the thick wire coil, which forms part of

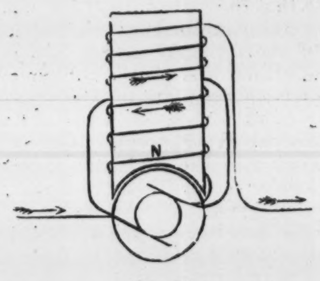


FIG. 11.

the main circuit, constitutes, with the armature, a brake-generator, so that the main current passing round this thick wire coil tends to demagnetise the field-magnet. Or, again, the shunt coil, which with the armature constitutes the motor, may be a shunt to both the armature and the demagnetising coil, as shown in Fig. 12.

The subject of governing motors may be mathematically investigated as follows :—

1st. *When constant potential difference is maintained between the mains feeding motors in parallel circuit.*

Let the arrangement shown in Fig. 7 be that adopted, and consisting of a magneto-motor and a series brake-dynamo.

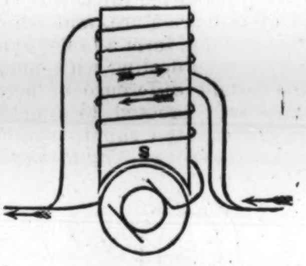


FIG. 12.

Let e be the back electro-motive force set up in the motor when n is the number of revolutions per minute at which it is turning ; let C be the current passing through it, then we know that

$$e = n\,(a - \mathrm{K\,C}),$$

where a is a constant depending on the permanent magnetism, and K on the coiling and the magnetic susceptibility of the steel magnet. But if E is the potential difference constantly maintained at the terminals of the motor, and R is the resistance of the armature and demagnetising coil combined, then

$$e = \mathrm{E} - \mathrm{R\,C}$$

but the total work the motor can do in consequence of its motion is

$$e\,\mathrm{C} = n\,(a - \mathrm{K\,C})\,\mathrm{C} = (\mathrm{E} - \mathrm{R\,C})\,\mathrm{C},$$

which we desire to be able to vary at will without varying n. The second equation is therefore true for all values of C, which is the only variable, hence we must have

$$n\,a = \mathrm{E},$$
$$\text{and}\quad n\,\mathrm{K} = \mathrm{R}.$$

But if we consider the dynamo part alone, the approximate equation for the early part of its characteristic curve would be of the form

$$e_1 = n\,\mathrm{K\,C}.$$

Consequently, since one of the conditions for governing is

$$n\,\mathrm{K} = \mathrm{R},$$

we conclude that the resistance of the armature and demagnetising coil combined is such that it is the critical resistance of the dynamo part of the combination for that speed at which it is desired the motor shall always run, no matter what amount of work it may be doing.

To better explain this, we will take an actual case and show how we experimentally determine the proper resistance to give to the governing demagnetising coil for any particular motor when the arrangement shown in Fig. 8 is employed.

Let f_1 be the resistance of the field-magnet of a series motor of any size and type, and a_1 the resistance of the armature. Pass a current, C_1, through the field-magnet only, and let e_1 be the electromotive force set up in the armature when it is rotated mechanically at a speed of n_1 revolutions per minute. If there be permanent magnetism in the field-magnet, then two experiments must be made, in one of which the permanent magnetism of the field magnet alone acts, while in the second both the permanent magnetism and the magnetism due to the current C_1 are combined, and e_1 then stands for the difference between the electromotive forces set up in the two experiments—that is, e_1 is the electromotive force due to the total magnetism produced by the current alone.

Then if the field-magnet of the motor be rewound with two coils, one occupying $\frac{1}{x}$ of its volume, and having a resistance f_2, and the other $\frac{1}{y}$ of an equally useful part of its volume, and having a resistance f_3, and if a current, c, passes through the former, and C through the latter, the electromotive force, e_2, set up in the armature coil, which, if rewound, may have a resistance, a_2, will at n_2 revolutions per minute be

$$e_2 = \frac{e_1}{n_1\,\mathrm{C}_1\,\sqrt{a_1 f_1}}\,n_2\,\sqrt{a_2}\left(p + c\sqrt{\frac{f_2}{x}} + \mathrm{C}\sqrt{\frac{f_3}{y}}\right)$$

where p is the term due to the permanent magnetism which by definition is inoperative as far as e_1 is concerned, but is effective in producing e_2.

If the coil of resistance, f_3, which is a continuation of the wire on the armature, as shown symbolically in fig. 13, be so wound as to diminish the total magnetism in the field-magnet, the above equation reduces itself to the form

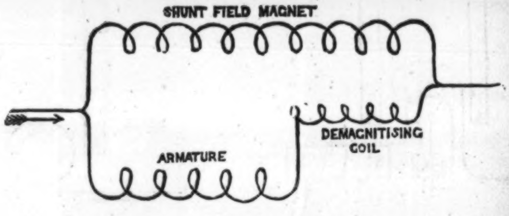


FIG. 13.

$$e_2 = n_2\,(s + tc - \mathrm{K\,C})\,;$$

and, reasoning as before, we obtain for constant speed, independent of the work the motor may be doing, the conditions

$$n_2\,(s + t\,c) = \mathrm{E}$$
$$n_2\,\mathrm{K} = a_2 + f_3,$$

where f_3 is the resistance of the regulating coil.

To determine f_3, we have

$$f_3 = n_2\mathrm{K} - a_2$$

$$\text{and}\quad \mathrm{K} = \frac{e_1}{n_1\,\mathrm{C}_1\,\sqrt{a_1 f_1}}\sqrt{\frac{a_2 f_3}{y}}$$

$$\therefore f_3 - \frac{n_2\,e_1}{n_1\,\mathrm{C}_1\,\sqrt{a_1 f_1}}\sqrt{\frac{a_2 f_3}{y}} + a_2 = 0$$

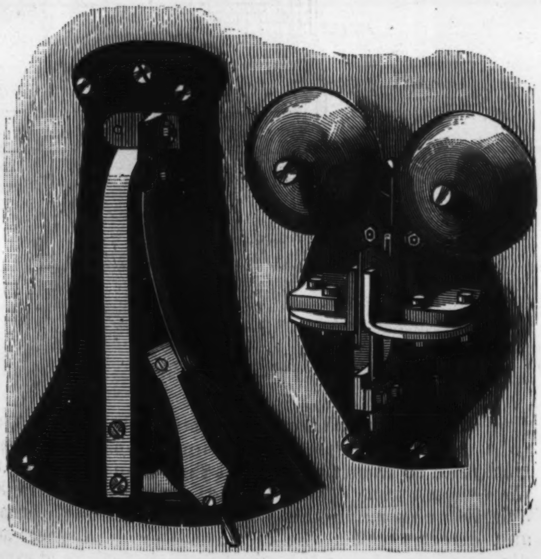
$$\therefore \sqrt{f_3} = \frac{\dfrac{n_2\,e_1}{n_1\,\mathrm{C}_1}\sqrt{\dfrac{a_2}{a_1 f_1 y}} + \sqrt{\dfrac{n_2^2\,e_1^2}{n_1^2\,\mathrm{C}_1^2}\,\dfrac{a_2}{a_1 f_1 y} - 4\,a_2}}{2}$$

a_1, f_1 are the resistances of the armature and field-magnet of the motor as received for trial, and are therefore known. e_1 is the electromotive force the motor sets up when it is revolved at n revolutions per minute, and a current, C_1, sent through its field-magnet. e_1, n_1, and C_1 are therefore determined experimentally; y and a_2 depend on the rewinding; a_2 may be made equal to a_1 if we like—that is to say, the armature need not be rewound ; y must be chosen judiciously, and its value is governed by the following considerations :—The presence of the governing coil diminishes the power of the motor, except when it is exerting its maximum power—not, however, by wasting the power, but by making the motor for the time being equivalent only to a smaller motor. Any form of governing an electric or any other motor must necessarily have this effect : for example, when a 20 horse-power steam-engine is only turning the shafting of a factory, and doing no other work, the steam may be so much cut off by the governor that for the time being the engine may only be exerting 2 horse-power, which quite a small engine could of course just as well exert. As a matter of economy in weight, &c., it is not of course desirable to use a motor which is very much more powerful than is necessary, or, in other words, it is not desirable that the amount of governing should be necessarily very large; hence $\frac{1}{y}$ should not be too large. On the other hand, $\frac{1}{y}$ must not be too small, or the whole governing action will be too small, corresponding with a steam-engine the governor of which has only a limited range. Probably $\frac{1}{y}=\frac{1}{5}$ and $\frac{1}{x}=\frac{4}{5}$,—that is, $y=5$ and $x=\frac{5}{4}$ will generally give very good results,—and those are the values we have employed in the one of our motors before you, which is thus governed by the combination of a shunt motor with a series brake dynamo. a_1, f_1, e_1, n_1, C_1, a_2, and y having been thus determined, n_2 merely depends on the speed at which we desire the motor always to run, so that f_3, the resistance of the regulating coil, can now be found.

(To be continued.)

A NEW MAGNETO-ELECTRIC CALL.

IT is desirable, in a great many cases, to dispense with the batteries which work electric bells, signals, &c., and to replace them by a magneto-electric system. In telephonic communication by means of a magnetic transmitter, for example, the installation will be considerably simplified by making use of a magnetic apparatus for actuating the signalling bell.



For long-distance telephony, the working of the bell requires a number of elements which increase in proportion to the distance, whilst a magnetic call works at a very great distance; it is therefore economical, says *La Nature*, to make use of it for a long distance, even conjointly with a microphone transmitter, since for this latter the number of elements required is nearly constant.

The apparatus designed by M. Abdank-Abakanowicz fulfils completely the conditions imposed by the applications which we have just pointed out and several others which may be easily understood.

The figure represents the transmitter and the corresponding receiving bell.

The transmitter consists of a horse-shoe magnet, between the branches of which vibrates a bobbin furnished with an iron core and fixed to the end of a spring of which the other end is rigidly fixed to the support of the apparatus. The bobbin is removed from its position of equilibrium between the branches of the magnet by pushing a button in the form of a handle disposed at the lower part of the bobbin and is then set free; under the action of the spring the bobbin vibrates rapidly like a pendulum between the branches of the magnet, and the wire which composes it is then traversed by a series of alternating currents which last until the bobbin has returned to its position of repose.

The currents thus developed take effect in a receiver formed of a second bobbin coiled upon a plate of sheet iron cut in the form of a double T and moving in a magnetic field produced by two permanent magnets. This double T piece carrying the bobbin is fixed upon a spring which allows of regulating its vibrations and rendering them practically synchronous with those of the transmitter, which increases the sensitiveness of the apparatus. The other end is furnished with a small brass ball which strikes alternately the two bells when the bobbin is traversed by the currents furnished by the transmitter.

The call thus formed is very simple in manipulation and working. It is enough to fix the transmitter rigidly upon a table or against a wall and to connect it with the receiver. To work it, we move the handle until it almost touches the stop which limits its course, and set it free. The currents developed by this system have the great advantage of producing no noise from induction upon neighbouring lines, by reason of their nature and the time of their vibration, which is less than one-sixteenth of a second, a lower limit than that of perceptible sounds. This, says our contemporary, is a valuable quality and one which should ensure its employment for telephonic service.

AN ELECTRICITY JOB.*

PUBLIC confidence in committees on private bills has been somewhat shaken by the blow-holes scandal, and apart from that it must be noted that we are now at the fag end of the season, when insidious measures can be thrust through the two houses without adequate consideration. However that may be, it is a fact that, during the last few days, Mr. Chamberlain and sundry interested persons have been engaged in perpetrating, or in endeavouring to perpetrate, a rank injustice and an outrageous job in the teeth of the great London parishes. It is to be hoped that the House of Lords will not fail to firmly withstand the completion of the little game.

Now it is, or should be known, that under the Electric Lighting Act there are three means by which parishes may be lit by electricity.

1st. A parish or local authority can apply for a licence for themselves.

2nd. Parishes or local boards can grant to a company permission to apply for a licence.

3rd. An electric company can apply to the Board of Trade for provisional orders.

The third method was clearly intended to meet cases where vestries or other local authorities stood out in a pig-headed fashion against an improvement in lighting. It is an extreme method, and altogether opposed to the idea of local self-government, inasmuch as it contemplates the forcing of electric light on a parish which does not want to have it. But it is well-nigh inconceivable that when a parish has decided to have an electric light, has selected a certain system, and has done all that is needful to give effect to this selection, by authorising the company to apply for a licence—it is, I say, well nigh inconceivable that *then* the local wishes should be set at nought, that a provisional order should be obtained for another light altogether, and the parish saddled with a grinding monopoly for twenty-one years. This has, however, happened, or is about to happen, unless the machinations of Mr. Chamberlain and his associates be defeated, and that in the following manner.

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* *St. Stephens Review*, August 4th.

A licence, it must be premised, holds good only for seven years, a provisional order operates for twenty-one years. This, considering that electric lighting is only in its infancy, constitutes an immense claim in favour of a licence, for it is more than probable that something utterly superior to any known system will be invented within twenty-one years. And now for the point. Some months ago the Strand district, including seven London parishes, chose the Jablochkoff light, and gave permission to the Jablochkoff Company to apply for a licence to light those parishes. All the necessary forms were complied with. Meanwhile, the Swan, Edison, and Brush Companies went in for the high-handed and extraordinary course of applying for provisional orders to light those same parishes for twenty-one years, and also to light Kensington, St. James's, Westminster, and the most part of London for a similar period. Here then was a case in which local authorities had arranged for their own electric light, had wisely adopted the course by which they would not be tied by any system for more than seven years; all seems going well—and suddenly there comes this rush of utter outsiders riding roughshod over them and their plans, and endeavouring to bleed them with a twenty-one years' monopoly. Mr. Chamberlain stated in the House of Commons on Tuesday that the parishes were *not* in favour of the Jablochkoff Company. This is simply untrue. The written consent of the Strand local authorities to that company's application for a licence is now on view, and, what is more, it was re-affirmed on last Wednesday.

Mr. Chamberlain further stated that the Jablochkoff Company were not financially able to carry out the lighting. This was simply impertinent nonsense.

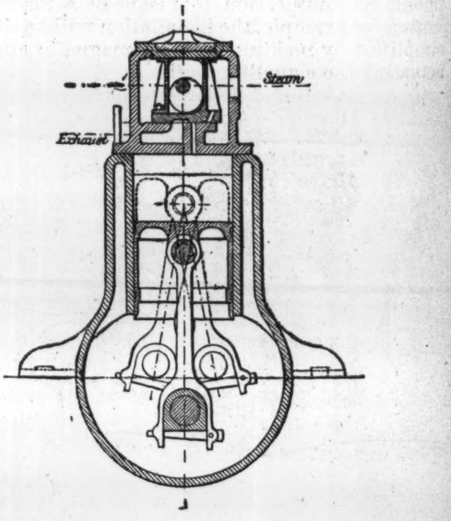
The Brush Company in due course stood aside from the contest, for a reason that may hereafter appear, when the Swan and Edison Companies find the necessity of providing an arc light. That they will find such a necessity is certain, if they gain their present point; for it has been abundantly proved that an incandescent light is unfitted for the streets, being little, if at all, superior to gas, and infinitely more costly. Therefore, when the companies find themselves obliged to provide an arc light, it may well be that the Brush will have some claim on their consideration. Apart from all this, I want to know whether it is a fact that Sir Lyon Playfair, who resigned the Chairmanship of of Committees some little time ago, is to be chairman of the Swan and Edison companies. This, if it be the case, may supply the key-note to these mysterious and tyrannical proceedings.

It is a matter of profound indifference to me which of the various systems of electric lighting is chosen, so it be done in a fair and open manner. What has been done is not fair and not open. Mr. Chamberlain stated, when attacked on the subject on Wednesday, that "the local authorities had been in no way over-ridden by the Board of Trade. Parliament decided that the power of deciding absolutely whether electric lighting should be introduced into a district should not rest with the local authority;" and nothing more disingenuous could have been stated. The power of deciding whether electricity should be introduced into a district does not, it is true, under the Act, *rest* with the local authority. That is to say, the *refusal* of the local authority will not necessarily prevent its introduction; but nowhere is it hinted that a local authority, willing to introduce the light, should be over-ridden and set at nought by an extraneous gang of speculators.

It is now for the parish authorities to move with all their might, so that the House of Lords* may be apprised in time of the full measure of the scandal which is being jockeyed through the legislature. It is not merely a monopoly which is receiving legal sanction, but a monopoly extending for twenty-one years, by which the whole, or almost the whole of London will be given up to a system of lighting which has never yet been successful out of doors, and which will, doubtless, have been far surpassed by other systems long before the time of bondage elapses; this too in preference to the only system by which streets have ever been continuously lighted. Add to this the fact that the parishes have been denied the very simple right to choose for themselves, that the prudent care by which they had arranged to tie their hands for the least possible period—viz., seven years, has been rendered of no effect, and we may in some measure realize what this tyranny of corrupt radicalism is bringing about. Monopolies of gas and water have been ere now condemned, but M. Lesseps would seem to have converted our ministers to a complete approval of a *pouvoir exclusif*. So London is to be given up to an electric monopoly—unless the Lords forbid.

WELFORD'S HIGH SPEED ENGINE.

WELFORD'S High Speed Engine (Ridealgh's patent) is exceedingly simple, and is one of the latest improvements in the high speed type of engine. It is manufactured expressly for driving dynamo-electric machines, torpedo boats, launches, rotary blowers, and indeed for any purpose where steam power is required. The advantages claimed for it are, that it supplies the want of a highly economical high speed steam engine, as it uses considerably less steam than other engines, which result is obtained by substituting an ordinary D slide valve, which works perfectly tight on the base of each cylinder, for rotary or piston valves, which work slack, and so wastefully permit the steam to go direct to the exhaust pipe. The distance from the valve to the cylinder pistons in this engine is exceedingly small and direct, so that the clearances or dead-spaces are almost nil, reducing the consumption of steam at every stroke, and, we understand, effecting over some engines an enormous saving. Particular attention is drawn to this latter point.



This engine is made usually with three *single acting* cylinders, and here it may be said that it is almost impossible to run reciprocating engines at high speed constantly, as the double action soon causes the bearings to require adjustment, and if the engine is not stopped and attended to a breakdown will usually follow. In single acting engines this is avoided, and in the engine now described working expenses amount to very little, the adjustment of brasses never being required.

It is designed and constructed to give the greatest steadiness, the twisting strain on crank-shaft being continuous and steadily maintained, and the whole engine being exactly balanced from the fact of having the three cranks set at angles of 120° with three vertical cylinders.

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* See our pages 113–114.—EDS. ELEC. REV.

These engines are extremely simple, which for Colonial purposes tells greatly in their favour, and belting is in many cases dispensed with, together with the trouble of its repair stoppages.

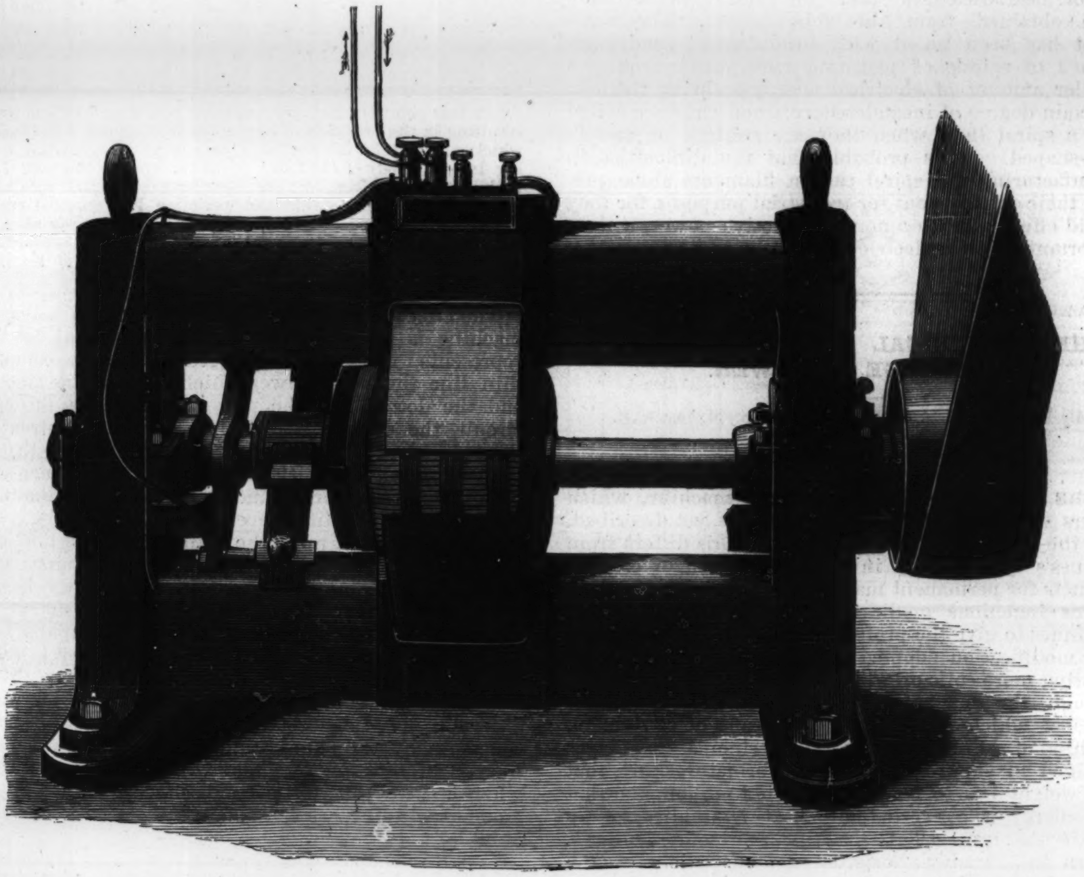
Everything about the engine is very accessible, and the whole is compact; they are usually fitted with one of the simplest forms of reversing gear.

These engines can be made compound. The sketch shows a sectional view of the engine.

THE CABELLA ARMATURE.

Electrical invention seems to be making remarkable progress in Italy. Among recent achievements in this direction a prominent place belongs to the new armature devised by Signor Cabella. The axle of the armature is covered with an insulating coating, in which are fixed, in suitable grooves, numerous little plates of copper cut from a sheet of a millimetre in thickness, in the form of a rectangular merimeter wanting one of its greater sides. In one of these armatures there are 300 plates of the form indicated, having a uniform breadth of 32 millimetres. These are held in their place by wedges of vulcanite compressed between the successive plates. The system of spirals of copper around the iron core forms a continuous spiral precisely as in Pacinotti's ring.

The entire resistance is very small, and may be calculated at 0·4* ohm. The advantages offered by the Cabella armature are, beside the smallness of its resistance, its solid and compact structure, which renders the disconnection difficult which in other forms of armature is produced by centrifugal force, and which permits the convex surface to be approximated to within one millimetre of the internal sides of the cavity. One of these armatures, of the diameter of five centimetres, has been recently substituted for the Edison armature in the cavity of its inductor in an Edison Z machine, used to feed 60 Edison A lamps, that is to say, of 16 candle power each. On giving a speed of 1,050 revolutions per minute, there was obtained a current sufficiently intense to keep burning with a beautiful clearness 150 such lamps, arranged in 15 derivations, with 10 lamps in parallel series in each. This result has been repeatedly obtained in trials, at which competent judges have been present by invitation. The engineers, Maroni and Ferrini, are of opinion that the armature in question constitutes a very notable progress in the construction of induction machines, and, consequently, in the production of the electric light. Certain improvements in detail hold out the promise of still more satisfactory results in future.



The description here given, taken from an Italian newspaper, is not very clear. The drawing shows a machine of 30, 50, 80, or 100 lamp type of 16 candle-power each.

THE NOTHOMB LAMP.*

This incandescence lamp is distinguished from its predecessors by the nature of the incandescent filament and the mode of manufacture. This filament consists of cellulose carbonised in a carburetted atmosphere which impregnates it with carbon. It is one millimetre wide and $\frac{4}{10}$ths of a millimetre thick; its length depends on the luminous intensity required. The atmosphere of the globe of glass in which it is inclosed consists of azote, hydrogen, or any other inert gas.

The filament is fixed to conductors by means of a special kind of cement, composed of a mixture of spongy platinum and an organic substance, molasses or sugar, which on carbonising forms carbon of very close texture and great consistency. The duration of the lamp, according to the experiments made, should be from 800 to 1,000 hours; the luminous power 30, 50, or 100 candles; there are thus four types, A, B, C and D, which work with currents of from one to three ampères and electro-motive forces of from 45 to 100 volts, according to the luminous power.

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* This should probably be 0·04 or less.—Eds. Elec. Rev.

* *L'Electricien*, August 1st, 1883.

By calculating the expenditure of energy corresponding to these constants and comparing it to the luminous power, we see that the Nothomb lamp, like all the incandescence lights, gives a light of from 250 to 300 candles per horse-power of electrical energy.

The type, D, of 300 candles, has three filaments, it requires 100 volts and nine ampères, or 300 volts and three ampères, according to whether the three filaments are coupled in series or parallel. While adopting the horse-shoe form of filament, the inventor acknowledges that the best results have been obtained from the spiral ones. The same effect has been noted with incandescent conductors formed of spirals of platinum wire which require a smaller amount of electrical energy to bring them to a certain degree of incandescence when they are coiled into a spiral than when they are straight or merely loop-shaped. It is probable that the difficulties in manufacturing the spiral carbon filaments alone prevent their employment for industrial purposes, for they would effect a real economy of motive power, a most important point in electric lighting by incandescence.

THE ELECTRICAL TRANSMISSION AND STORAGE OF POWER.

By Dr. C. WILLIAM SIEMENS, F.R.S., M. Inst. C.E.

(*Continued from p.* 101.)

THERE is another form of dynamo machine, which differs essentially from those I have as yet described, viz., the alternate current machine. This differs from Holmes's type, chiefly in the substitution of electro-magnets for permanent magnets, although De Meritens in his ingenious modification of Holmes's machine continues to give the preference to permanent magnets. The modification adopted by my firm consists in substituting mere coils of wire for the armatures, rotating through the magnetic fields produced by electro-magnets which are excited by means of a dynamo machine of the original type. The principal advantages obtained in suppressing the iron armatures, are, that less weight has to be put into rapid motion, and that less energy is converted into heat by eddies set up within the iron. This machine represents in fact a return to Faraday's original demonstration of the current set up in a conductor passed through a magnetic field, and it is interesting to observe by inspection of Table I., that these machines give the highest yield of electrical energy for a given expenditure of mechanical power. This Table contains a considerable amount of practically useful information. The machines marked D in the first column are of the self-exciting type first described; those marked S D (S meaning shunt) are wound in the manner of a parallel circuit as next described, and those marked W are the alternating current machines to which I have just referred. The second column gives the number of incandescent lights which each machine will sustain. That is perhaps of little importance to our present enquiry; but in another column, to which I would draw particular attention, you have the relative effect per lb. of copper wire in the different machines, and the enormous difference in the values shows sufficiently what scope there is for the development of the dynamo machine. For instance, in one machine, 1 lb. of copper produces only 17 watts, or units of electric energy; and in another—the last which has been produced—the effect is 48.

TABLE OF PARTICULARS OF DYNAMO AND ALTERNATE CURRENT MACHINES.

Type of Machine.	Number of Incandescent Lamps of 45 Volts and 1·31 Ampères.	Number of Watts.			Total Number of Watts developed.	Percentage of Total Watts made useful in Outer Circuit.	Total Weight of Copper Wire on Machine in lbs.	Number of Watts in Outer Circuit per lb. of Copper Wire in Machine.	Approximate Circumferential Speed of Helix in Feet.
		In Helix.	In Electro Magnets.	In Outer Circuit.					
S D 5	12	120	248	796	1,164	68·0	43	18·6	1,900
S D 7	25 × 2	308	370	3,316	3,994	83·0	113	29·0	2,750
"	40	328	233	2,653	3,214	82·0	141	17·9	2,150
S D 2	30 × 2	536	319	3,980	4,835	82·0	262	15·1	1,836
"	60	526	326	3,980	4,832	82·0	261	15·2	1,900
S D 1	60 × 2	803	532	7,959	9,294	85·0	582	13·6	2,050
"	50 × 3	615	1,200	9,949	11,764	84·5	582	17·0	2,600
D S D 0 0	150 × 2	2,080	2,562	19,890	24,532	81·7	857	23·1	2,150
B 1	400	1,654	2,666	26,532	30,851	86·0	812	32·5	2,750
W 3	60	193	456	3,979	4,868	81·7	227	17·4	3,650
D 5	..	97	143	..	..	..	..	..	1,550
W 6	90	335	595	5,969	7,240	82·0	312	17·0	4,100
D 6	..	121	220	..	..	..	..	..	1,750
W 2	120	630	633	7,959	9,523	83·5	360	22·1	4,400
D 6	..	107	194	..	..	..	..	..	1,850
W 1	200	1,307	1,257	13,266	16,034	82·7	523	25·3	4,800
D 7	..	110	94	..	..	..	..	..	2,150
W 5	400	1,034	1,496	24,030	26,777	90·0	502	48·0	5,780
D 7	..	117	100	..	..	..	..	..	2,230
W 0	500	1,537	2,375	33,165	37,460	88·0	847	38·9	6,500
D 2	..	177	206	..	..	..	..	..	1,900

[At this point the lecturer was interrupted by a violent report, resulting in the breakage of some glass in the dome of the theatre, which, fortunately, fell outwards, only slight fragments descending into the body of the hall. Windows towards the back of the building were broken, but the Secretary having at once taken steps, and ascertained that the explosion had occurred outside, the lecturer immediately resumed; and it was only after the lecture that it was known that the real cause of the report heard was the explosion of dynamite below the offices of the Local Government Board.]

The effect of variation of the resistance of a dynamo machine is given in fig. 2. The dash and dot line represents the electromotive force in volts, the complete thin line the horse-power which the machine absorbs, and the dotted line the power developed in the outer circuit, the complete thick line gives the current in the outer circuit in ampères. You will observe that in proportion as the resistance of the machines increases, both the power expended and power developed diminish, the loss being the difference between these lines. The effect is the height up to the dotted lines, and it at once becomes evident that the best result is obtained with not quite 1 ohm resistance. Fig. 3 shows how a dynamo in series differs from a dynamo in shunt. In an ordinary dynamo, the effect increases rapidly with increase of velocity. If the machine were set to work, say with incandescent lights, it will be seen that it would at a low speed give very poor results; but when a certain speed had been obtained, it would be more constant; by the shunt winding, you find, on the contrary, a diminution of effect with increase of speed; whereas in a third (the composite, before described) mode of winding, we can obtain the greatest constancy of effect.

I shall now show you some of the effects that can be produced in transmitting power. In a yard adjoining this Institution a portable steam engine has been erected giving motion to a D 2 dynamo machine, capable of developing about 8 H.P. of electrical energy, or 746 × 8 = 5968 Watts. This power is conveyed through an insulated wire to the coils of a D 7 dynamo machine, the rotating axis of which is practically in one piece with that of a centrifugal pump, by means of which water can be raised in considerable quantities, and when forced through a nozzle may be lifted 60 feet high. The mechanical effect thus realised amounts to 3¾ H.P., deduction being made for frictional losses of every kind, and the experiment is interesting as showing a practical application of electric energy to useful purposes. Considering that the weight of the machine is only 3½ cwt., and of the pump about the same (the total being at any rate within half a ton), and that the power could be easily augmented to 5 or 6 H.P., I think we may look forward to the time when our fire engines will be worked on this principle.

The Electric Storage Company have been kind enough to send me some of their batteries, and I shall turn their current upon this machine in order to produce the same results as shown before. In this instance the effect, originally produced by the steam-engine, has given motion to a dynamo machine, the electricity from which has been transferred to the secondary battery, where it has produced chemical action such as I shall presently describe. The store of chemical effect thus produced within the battery is now made available in forming a current, which, passing through the dynamo machine connected with the pump, imparts motion to the latter. I will now connect the current with a second dynamo machine to work a saw bench, giving motion at the same time to another dynamo machine, wound with comparatively thick wire in order to set up a current of very low electrical potential. The potential of the dynamo machine outside the building is equal to 100 volts, but it is inconvenient sometimes to use a current of such high tension, and my object in transferring the power derived from a machine of high potential to another dynamo machine wound with thick wire is to obtain a current of low potential, which in this instance does not exceed 10 volts. Such a current could not harm a child, but is most effective where quantity rather than high potential is required, as for instance, for electrolytic purposes. This is what may be called a tertiary machine, and you will observe that it has more effect than either the primary or secondary in heating an iron wire of considerable thickness ($\frac{1}{8}$th of an inch thick) it being what is called a quantitative current. We will now connect the current with a little toy railway, and you will see the result. I may call this a quaternary transmission of force. The steam-engine transferred its energy to a dynamo machine; this dynamo machine gave motion to a second, that to a third dynamo machine, and this again has given motion to the carriage upon the rails, which latter perform the function of conducting wires. The same power has thus been four times transmitted, showing the great facility with which we can reconvert it again and again from mechanical into electrical, and from electrical into mechanical, effect; and alter its character from a current of high potential to a current of low potential, or *vice versâ*.

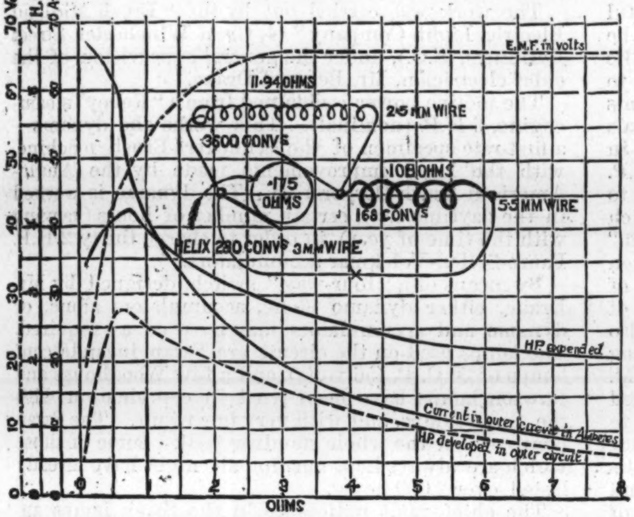

FIG. 2.

EXPERIMENTS MADE ON THE 21ST OF FEBRUARY, 1880, WITH D_2.

I will now allude to an application of electricity lately made by Dr. John Hopkinson, which appears to me to be full of promise. Mr. Nebel will set it to work. It is an electrical hoist. Imagine this to be at the top of a warehouse, and the chain ten times as long as it could be made in this instance, and you will observe that by putting on the current of this dynamo machine, the weight (which might be much heavier), will be lifted readily, and may be stopped and lowered at will according to the position of the brushes upon the dynamo-commutator.

Another application which has been made with great effect, is that of raising the wire which is used in sounding by Sir William Thomson's wire-sounder. On board the *Faraday*, the machine has been employed, and the wire is drawn up in an extraordinarily short space of time. We find that by these means we can make a sounding in 2,500 fathoms in a hour, because we can go on with the steamer while the electric machine is pulling in the wire. The only drawback which was found in the early trials was that, the machine having been placed near the compasses, the latter were influenced magnetically; the caution, therefore, to be observed, is to put it in a part of the ship away from the compasses.

When losses by unnecessary wire-resistance, by Foucault currents and by induced currents in the rotating armature, are avoided, as much as 90 per cent., or even more, of the power communicated to the machine is realised in the form of electric energy, and *vice versâ* the reconversion of electric into mechanical energy can be accomplished with similarly small loss. Thus, by means of two machines at a moderate distance apart, nearly 80 per cent. of the power imparted to the one machine can be again yielded as mechanical energy by the second, if we leave out of consideration frictional losses, which latter need not be great, considering that a dynamo machine has only one moving part well balanced, and is acted upon along its entire circumference by propelling force. Jacobi proved, many years ago, that the maximum efficiency of a magneto-electric engine was obtained when

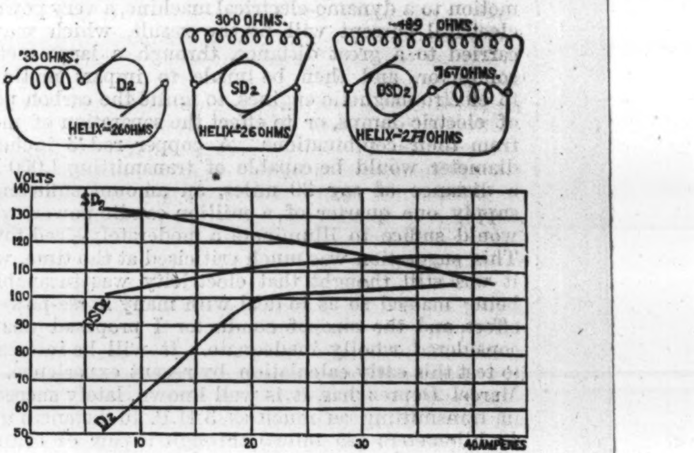

FIG. 3.

E. M. F. CURVES—D_2, $S\,D_2$, $D\,S\,D_2$,

$$\frac{e}{E} = \frac{w}{W} = \frac{1}{2}$$

which law has been construed, by Verdet (Théorie Mechanique de la Chaleur) and others, to mean that one-half is the maximum theoretical efficiency obtainable in electric transmission of power, and that one-half of the current must be necessarily wasted or turned into heat. I could never be reconciled to a law necessitating such a waste of energy, and have maintained, without disputing the accuracy of Jacobi's law, that it has reference really to the condition of maximum work accomplished with a given machine, whereas its efficiency must be governed by the equation

$$\frac{e}{E} = \frac{w}{W} = \text{nearly } 1.$$

From this it follows that the maximum yield is obtained when two dynamo machines (of similar construction) rotate nearly at the same speed, but under these conditions the amount of force transmitted is a minimum. Practically the best condition of working consists in giving to the primary machine such proportions as to produce a current of the same magnitude, but of 50 per cent. greater electromotive force than the secondary; by adopting such an arrangement, as much as 50 per cent. of the power imparted to the primary could be practically received from the secondary machine at a distance of several miles. Prof. Silvanus Thompson, in his recent Cantor Lectures, had shown an ingenious graphical method of proving these important fundamental laws.

The possibility of transmitting power electrically is so obvious that suggestions to that effect have been frequently made since the days of Volta, by Ritchie, Jacobi, Henry, Page, Hjorth, and others; but it is only in recent years that such transmission has been rendered practically feasible.

Just six years ago, when delivering my presidential address to the Iron and Steel Institute, I ventured to suggest that "time will probably reveal to us effectual means of carrying power to great distances, but I cannot refrain from alluding to one which is, in my opinion, worthy of consideration, namely, the electrical conductor. Suppose water-power to be employed to give motion to a dynamo-electrical machine, a very powerful electrical current will be the result, which may be carried to a great distance, through a large metallic conductor, and then be made to impart motion to to electro-magnetic engines, to ignite the carbon points of electric lamps, or to effect the separation of metals from their combinations. A copper rod 3 inches in diameter would be capable of transmitting 1,000 H.P. a distance of say 30 miles, an amount sufficient to supply one quarter of a million candle-power, which would suffice to illuminate a moderately-sized town." This suggestion was much criticised at the time, when it was still thought that electricity was incapable of being massed so as to deal with many horse-power of effect, and the size of conductor I proposed was also considered wholly inadequate. It will be interesting to test this early calculation by recent experience. M. Marcel Deprez has, it is well known, lately succeeded in transmitting as much as 3 H.P. to distances up to 40 kilometers (25 miles) through a pair of ordinary telegraph wires of 4 millimetres diameter. The results so obtained were carefully noted by M. Tresca, and were communicated to the French Academy of Sciences. Taking the relative conductivity of the iron wire employed by Deprez, and the 3-inch rod proposed by myself, the amount of power that could be transmitted through the latter would be about 4,000 H.P. But Deprez employed a motor-dynamo of 2,000 volts, and was contented with a yield of 32 per cent. only of the power imparted to the primary machine, whereas I calculated at the time upon an electromotive force of 200 volts, and upon a return of at least 40 per cent. of the energy imparted. Sir William Thomson at once accepted these suggestions, and with the conceptive ingenuity peculiar to himself, went far beyond me, in showing before the Parliamentary Electric Light Committee of 1879, that through a copper wire of only ½-inch diameter, 21,000 H.P. might be conveyed to a distance of 300 miles with a current of an intensity of 80,000 volts. The time may come when such a current can be dealt with, having a striking distance of about 1·2 foot in air, but then, probably, a very practical law enunciated by Sir William Thomson would be infringed. This is to the effect that electricity is conveyed at the cheapest rate through a conductor, the cost of which is such that the annual interest upon the money expended equals the annual expenditure for lost effect in the conductor in producing the power to be conveyed. It does not appear that M. Deprez has considered the effect of this economic law upon his recent experiments.

Sir William Armstrong, in the year 1878, was probably first to take practical advantage of these suggestions in lighting his house at Cragside during night-time, and working his lathe and saw-bench during the day, by power transmitted through a wire from a waterfall nearly a mile distant from his mansion. I have also for some years accomplished the several objects of pumping water, cutting wood, hay, and swedes, of lighting my house, and of carrying on experiments in electro-horticulture from a common centre of steam-power. The results have been most satisfactory; the whole of the management has been in the hands of a gardener and of labourers, who were without previous knowledge of electricity, and the only repairs that have been found necessary were one renewal of the commutators and an occasional change of metallic contact brushes.

(*To be continued.*)

ELECTRIC LIGHTING AT ASCOT.

[A COMMUNICATION.]

ST. GEORGE'S School, Ascot, has been lighted throughout by the electric light since February last. As this is one of the first installations in a private house, it may be interesting to the public to know something about it.

The work was carried out by the "Brush Midland Electric Light Company" (4, Great Winchester Street Buildings, E.C.), under the general supervision of the chief electrician, Mr. Bernard Drake.

The motive power is obtained from a "Robey" steam-engine, 6 H.P. (nominal). This works the dynamo—a first-rate specimen of the Schuckert-Brush machine, with the latest improvements made by the Anglo-American Brush Corporation. The dynamo is worked in the daytime for a certain number of hours (varying with the time of year), in order to charge thirty 2 H.P. Faure-Sellon-Volckmar accumulators.

By means of a "four-way" switch, designed by Mr. Drake, either dynamo alone, accumulators alone, or dynamo and accumulators may be used as required. The lamps used on the circuit are Swan incandescent lamps of 20 C. P. (56 volts), and a few Woodhouse and Rawson lamps have been tried in combination with the Swan lamps, and with very fair result. The Swan lamps are on the whole standing well. Some of those which are always kept burning all night have already lasted over 2,000 hours.

The chief fault noticeable in the Swan lamps appears to be in the metal loops by which they are attached to the holders. Several lamps have given trouble from the loops being too large for the hooks, or from these loops breaking. It would seem also that the Swan lamps are not always thoroughly tested before being sent out. In this installation out of 150 lamps supplied direct from the Swan Works, over 30 gave way or burnt very dull within a few weeks. This is a pity, as the Swan lamp has proved itself in the same installation to be a splendid lamp for lasting.

A Swan lamp which burnt well and had lasted for a considerable time was sent up to Messrs. Woodhouse and Rawson, with a request that they would supply a few of their incandescent lamps of the same resistance. The Swan lamp E. M. F. was given by the Swan Company as 56 volts. Messrs. Woodhouse and Rawson declared it to be only 47 volts, and accordingly supplied a few of their lamps with E. M. F. 47 volts, the result being that the Woodhouse and Rawson lamps give a far brighter light than the Swan. Their lasting power remains to be proved.

The greatest possible care was taken by Mr. A. Brown (the electrician in charge of the installation for the Midland Brush Company) in running the various cables throughout the building. A fusible plug is supplied for each lamp; no wires are visible in the house, as they are all covered with a wooden beading; all cable used being moreover very thoroughly insulated. A large fusible plug is inserted in the main circuit in the engine shed. Thus it will be seen that every precaution has been taken to prevent risk of fire. The work, when complete, was inspected and passed by the surveyor of the "Alliance" Fire Insurance Company.

A few remarks must now be made on the "Faure-Sellon-Volckmar" accumulators, which were put up by the Electrical Power Storage Company. There can be no doubt that this company have made several important improvements in their accumulators since January last, and they certainly behave very liberally in giving their customers the benefit of these improvements made from time to time. The great fault, *at first*, was that the small squares in the plates kept continually dropping out, thus causing connection between the plates. This, however, has been greatly remedied of late, the new plates sent out being much more stronger and more satisfactory in every way.

In using accumulators, *everything* depends on careful management: the charging must be regulated according to the rate of discharge on the previous night; the boxes must be constantly tested, and the plates kept apart by means of a thin stick inserted in between from time to time for the purpose.

If they are carefully managed there is not the least doubt that accumulators are of the greatest possible use in an installation for several reasons. (1) A *perfectly steady* light is maintained (which is impossible from the best dynamo); (2) the engineer is not required at night; (3) the lamps last longer; (4) their use is economical, as it is not necessary to burn more than the exact number of lamps required at any one time. It should be stated that all the electroliers and brackets used at St. George's School were supplied by Messrs. Verity, of King Street, Covent Garden, and the opal glass shades and flowers by Messrs. Jas. Powell and Sons, of the Whitefriars Glass Works.

The success of the installation may, after an experience of five months, be pronounced complete. The light proves to be particularly pleasant for reading and working, and a most agreeable change from the colza-oil lamps formerly in use.

As regards the important question of expense, it is confidently believed that the electric light will prove to be considerably more economical than the former method of lighting employed, account being taken of the uses to which the steam-power may be applied—*e.g.*, the waste steam now works a "Tangye's Steam Pump" in the well which pumps the water to the top of the house, whereas formerly a pony was kept on purpose to do the pumping. Moreover, the perfect *cleanliness* of the electric light will very considerably diminish the amount of repairs which were formerly necessary in painting and whitewashing walls and ceilings.

The Head master of St. George's School, Ascot (the Rev. H. W. Sneyd-Kynnersley), will be glad to show the installation to any gentlemen interested in electric lighting.

FRESH CAPITAL.

THERE have just been issued two circulars,* one by the Anglo-American Brush Electric Light Corporation, and one by the Pilsen, Joel, and General Electric Light Company (the latter supplemented by a report of the directors and a statement of accounts), both companies making calls on the holders of shares not fully paid up, the Anglo Company of £1 per share, and the Pilsen Company of 10s. per share. Both companies necessarily, in asking for more money, speak hopefully of the future, but as only one of them, namely the Pilsen-Joel Company, issues a report and statement of accounts, we are unable to decide how far the Anglo Company is justified in taking the step it has. We shall, therefore, simply premise that the action of Parliament has undoubtedly checked hitherto the development of electric lighting business, and confine our remarks mainly to the report and accounts of the Pilsen Joel Company.

Temporarily, we will pass by the first paragraph. The second states "that a large portion of the operations of the factory has been devoted to experiments with a view to improvements and economy in the construction of the several forms of the company's apparatus." Now the Pilsen lamp and the Joel lamp were alluded to in the original prospectus of the company, the former as being pre-eminent for simplicity, and "it burns in absolute silence, with a steadiness, softness, and brilliancy which, under similar conditions, it is believed have not hitherto been attained;" whilst the latter is alluded to in these terms: "The system which lights the Pompeian Court of the Crystal Palace is the only semi-incandescent light exhibited, and it is believed that no other electric organization in the three kingdoms can offer to supply a workable light upon this very valuable system." We are informed also, by the prospectus, that the Pilsen lamp obtained, on its merits, at the Paris Exhibition, a gold medal, and the Joel light at the same exhibition obtained one of silver. The dynamo used has been known for years, in this country, as a good machine, and the Gatehouse lamp, only, was alluded to as requiring perfecting. It is, therefore, a matter for the consideration of the shareholders whether the sum of £5,695 10s. 5d., appearing under the head of expenses of experimenting, &c., is properly chargeable in that manner, especially when, as we see, the working account shows besides a balance to the bad of £5,155 2s. 11d.

The Directors certainly could not, under the circumstances, have been wrong in reducing "the manufacturing expenditure to a minimum," for the supply of apparatus has been considerably in advance of the demand. The total receipts, from sales and rents, being £3,112 17s. 1d., whilst the total stock and materials, &c., equal (less depreciation) £18,130 14s. 8d. By the way, the question of depreciation is important, for we hear of such little items as 500 Pilsen lamps being in stock, of which there is no prospect of getting rid, which will not work without further adjustment, and which are not to be compared with similar lamps of foreign make.

"The Directors are negotiating and arranging with corporations, &c., &c." So they were, when the prospectus was issued, for they say therein the sources from which they expect to derive profits are:—"The selling or licensing its rights to subsidiary companies for the British Colonies and different districts of the United Kingdom. Negotiations are now pending, and large results may fairly be anticipated from this source." What is the value of such promising negotiations?

The Directors "do not anticipate having to make another call, except for the purpose of carrying out provisional orders, &c.," and in this statement they are at least far-seeing. For under similar circumstances another call would not be paid, but possibly the next time a similar want of cash arises, the action of Parliament or badness of business will make it desirable to voluntarily wind up altogether. Even this would be better than foolishly spending more money, and it is this latter event against which the shareholders have to guard. Who is to manage the manufacturing department in future? The company's engineer is, we learn, about leaving, and we unhesitatingly protest against anyone without knowledge of electricity and without practical experience of works and workmen, having the control of such an important spending department.

Confidence in the extensive adoption of electric lighting in an early future is, we think, too strongly expressed, and the belief of the directors "that they have laid the foundation of a *profitable* business" quite too delightfully hopeful; but even if such things turn out as anticipated, all will be spoilt if no better guarantees are to be had than the very roseate promises of these over-confident Directors.

The balance sheet, if one takes those items only which are legitimate assets—that is to say, excepting expenses parliamentary, adaptation of factory, experimenting, exhibitions, and free installations; advertisements, pamphlets and circulars, &c., including the before-mentioned £5,155 2s. 11d., shows a balance to the bad of £14,520 11s. 7d., and even that is supposing the plant and stock are taken at their proper value. Shareholders will do well to give their support, if the future management is to be in the hands of men who are fitted for their work—at the factory a first-class technical adviser, at the office a gentleman of sound commercial ability, *with a prospect of both working in concert.* Without these guarantees the further call would be far better in the pockets of the shareholders.

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* See "City Notes, Reports, &c."

To return to the first paragraph. The directors consider that "the results of the working will be found to be by no means discouraging." We think otherwise, but we do so mainly because we lack confidence in the management, which, believing itself all that could be desired, has shown itself utterly incompetent for the task it had to do. Unless we are mistaken, if the above guarantees are not obtained, the future will only bring forth equal, or possibly worse, results.

NOTES.

Electric Lighting.—The experimental lighting of Commercial Street, Dundee, which was begun last November, was discontinued on Sunday evening. Pending the sanction of Parliament, the Brush Electric Light and Power Company, Scotland, are making arrangements for a site for their permanent works in Dundee. It is reported that a suitable place has been found in Ward Road, where the necessary engines for the central station are to be erected.

It is reported that the Nottingham Corporation will oppose the application of the Telegraph Construction and Maintenance Company for powers to light that town, the object of the opposition being to keep the supply of electricity under the control of the Corporation.

On Friday evening of last week the Indian troopship *Malabar*, Portsmouth, was successfully lighted throughout with Edison's incandescent light, with which all the Indian troopships are to be fitted. The ship from stem to stern, from stokehole to yardarm, is lighted with 114 16-candle and 286 8-candle lamps.

In the House of Lords on Thursday of last week, Lord Thurlow moved that the Standing Orders of the House against reading a second time Bills for confirming provisional orders brought from the House of Commons after June 26 should be dispensed with in order that the Electric Lighting Provisional Orders Bills Nos. 5 and 8 might be read a second time. The Bills were important ones, and largely affecting metropolitan districts. The Marquis of Salisbury asked whether any agreement had been come to by which the arrangements for the St. James's district were to be thrown open to a wider competition than that provided for under the Bill. Lord Thurlow said no agreement had been come to, but the Bill would probably have to be referred to a select committee. The motion was agreed to, and the Bills read a second time. The Electric Lighting Provisional Orders (Nos. 2, 3, 4, 9, 10, and 11) Bills passed through committee, and were reported to the House.

The lighting of the Parliament House at Melbourne by the Australasian Electric Light Company has been a great success. Seventy-eight gas jets have been replaced by 70 Lane-Fox incandescent lamps, and the result, according to the report in the *Argus*, is largely in favour of the electric light—not only as to light given, but as to the effect upon the atmosphere. The dynamo in use is the new "Brush" incandescent 100-lighter. A "Ferranti" 250-lighter has also been erected by the same company, and is kept in reserve.

The forthcoming meeting, commencing on September 19, of the British Association is to be held in the buildings of the Winter Gardens at Southport. These consist of a concert hall, a promenade gallery, a conservatory, an aquarium and a rink, and are to be lighted for the occasion by Messrs. Siemens Brothers, who are taking the opportunity to show, among other things, the systems adopted by them for the electric lighting of steamships. There will be eight arc lamps in the conservatory, in addition to four that are permanently installed there, three arc lamps in the promenade, four in the pavilion, two in the main staircase, six in the rink, and four very large ones in the gardens. Besides these there will be 160 Swan lamps. The current will be supplied by five generators, each driven by a separate engine, and it will be more particularly in this part of the exhibit that the interest will lie. The first is an alternate current machine with a separate exciter (W^1 D^7) driven by ropes. The remainder are compound wound dynamo machines of various sizes, said to be each provided with a separate Tangye engine and driven by a novel arrangement of frictional gearing.

The Jablochkoff Company suspended the lighting of the Thames Embankment during the past few days for the purpose of erecting a new Davey-Paxman engine in the station at Charing Cross. It is nearly five years since the old engine, by Ransomes and Co., of Ipswich, was put in, and the work which it has performed during that time speaks well for the firm's reputation.

What a strange muddle the Commissioners of Sewers seem to be getting into with regard to the lighting of the streets! We can all remember, says the *City Press*, the flourish of trumpets with which the first experiments were tried; and the Siemens system and the Brush system held up to public admiration as having solved the problem that was submitted to them, and established to the satisfaction of all the infinite superiority of electricity over gas for street lighting. Then came the report of the engineer, after 12 months' trial, demonstrating that, though the two systems were equally successful as lights, the cost of the Brush system was little more than one-third of that of Mr. Siemens. Thereupon followed the collapse of the latter system, and shortly afterwards came the mysterious refusal of the Brush Company to light the rest of the City on any terms, the only intelligible explanation being that as the engineer's report had sent up their shares from between £20 and £30 per share to something between £60 and £70, the reason of their low tender was at once seen. Since then other systems have been tried, all with more or less success, but it seems that now, in the middle of autumn, and within little more than four months of our shortest day, our streets are to be relegated to that miserable gas-lighting that we had fondly hoped had become a thing of the past. A special committee was formed some months ago, as we thought for the very purpose of throwing, as it were, a ray of the beautiful electric light into these dark proceedings, but we hear nothing satisfactory as regards the result. But the very last thing we do hear is, that the beautiful system, whichever it was, that so excited our admiration in Queen Victoria Street, has been abandoned on account of some paltry increase in the payment required for its continuance. Some of the abundant talent and energy of the Chairman of the Commission might be very beneficially employed in evolving order and light out of the chaos of muddle and obscurity into which this important matter seems to have drifted.

The use of the electric light in Bombay has led to a difficulty which was not foreseen. The lights at present in use on Malabar Hill can be seen from a great distance on account of their brilliancy and the height at which they are placed; and it appears that they have caused some doubt in the minds of mariners approaching Bombay Harbour as to the right course for them to steer. This has led to a recommendation to the port trustees by the resident engineer that the electric lights on Malabar Hill should be masked on the seaward side, "as, being placed at a higher elevation than either the Prongs or Kennery lighthouses, they are apt to cause confusion." The trustees have decided, however, says the *Bombay Gazette*, not to take any action at present, but to wait till further experience is gained.

Surprise has been created by the announcement made by Mr. Calcraft, assistant-secretary to the Board of Trade, to the Electric Lighting Committee of the House of Lords, that the board had decided to refuse to grant licences for the lighting of large and important districts involving a considerable outlay of capital. The general impression hitherto, we need scarcely say, has been, that if the local authority was willing to issue such licences the Board of Trade would consent, as a matter of course, provided the stipulations of the Electric Lighting Act were complied with. The Act, however, only empowered and did not compel the Board of Trade to grant such licences, and the effect of its decision is to leave the responsibility of all the most important engagements of this kind with Parliament. As a consequence, a number of schemes must remain over for legislative sanction next year.

Foreign Telegrams.—The South of Scotland Chamber of Commerce, at the last meeting, agreed to intimate to the Associated Chambers that the South of Scotland Chamber would move for a deputation to wait on the Postmaster-General in support of a reduction of the charges on foreign telegrams.

The American Telegraph Operators' Strike.—This strike shows signs of a collapse. A committee, representing the telegraph operators, but not their Brotherhood, has inquired the terms upon which they would be received back. In reply they were told to inquire of their immediate superiors. At the opening of the stock market on Tuesday, only about 50 of the numerous telegraph instruments used for recording the prices of stocks could be worked, the wires connected with the remainder having been cut, it is supposed, by the telegraphists on strike. The conclusion arrived at by the American public is, that the only remedy against an evil of the nature of the present condition of affairs is for the Government to assume control, as in Great Britain, of the telegraph wires, and to make the system an adjunct of the Post Office Department, and subject to its regulations.

A Rotten Telegraph Pole.—Benjamin Wyllie, twenty-four years of age, in the employment of the Glasgow City Union Railway Company's telegraph department, had his right thigh bone broken through falling to the ground from the top of a telegraph pole on the railway near Garngad Road on Saturday last. For the purpose of unfastening a wire on the head of the pole Wyllie placed a ladder against the post, and while he was at work it snapped near the ground, and he fell a distance of twenty feet. The injured man was taken to the Royal Infirmary in a cab. He belongs to Edinburgh.

The Telegraph at the New Law Courts.—An official from the Post Office was present at the Royal Courts of Justice on Tuesday, in order to make arrangements for the establishment of a telegraph office. A small apartment hitherto appropriated to the use of solicitors, near the entrance to the Central Hall, will be fitted up for the purpose, and the arrangements will be completed by the time the courts reopen in November.

Telegraph Wires.—In the House of Lords, on Monday, Viscount Sidmouth asked her Majesty's Government whether in the extension of the telegraphic system which was now contemplated they intended to consider the feasibility of carrying the wires underground, as was done in some other countries, instead of upon unsightly poles, according to the present universal practice in Great Britain, to the detriment of beautiful scenery.—The Duke of Buccleuch referred to the excessive risk of accidents to the public, especially during the winter, when snowstorms and heavy rains broke down the telegraph poles, which fell across the roadways.—Lord Thurlow said the subject had engaged the attention of the Post Office department, and the Postmaster-General had every wish to adopt the suggested improvement of conveying telegraph wires underground. It was, however, impossible to adopt the system generally, because of the additional expense it would entail; but as regarded large towns, the Post Office would continue, as far as possible, in the course they had for some time pursued, viz., that of laying wires underground. The practical observation of the noble Duke would receive the attention of the Postmaster-General.

The Portrush Electric Railway.—It is now definitely decided that Earl Spencer will open the electric railway from Portrush to Bushmills on September 14th. His Excellency and the Countess Spencer will be the guests of Sir Harvey Bruce, M.P., and the scientific gentlemen who will be present, while on their way to the British Association meeting at Southport, will be the guests of Dr. Traill, chairman of the company.

Telephonic.—Workmen are now engaged on the erection of a telephone line from Ballater to Balmoral Castle. The poles are being placed along the north side of the turnpike road, and cross the Dee at Crathie to the house of Dr. Profeit, and thence to Balmoral and Abergeldie. Everything is expected to be completed by the 25th inst., the day fixed for the Queen's arrival at Balmoral.

For the permission given by the Broughty Ferry Commission to the National Telephone Company to erect poles for telephone wires along the streets of the burgh, the Commissioners have been informed that a wire for the use of the Commissioners will be set apart, and for which no rental will be demanded.

Telephonic communication in Bradford.—At the request of Lieutenant-Colonel Crossley the National Telephone Company has put up a telephone wire between their offices in Swan Arcade, Bradford, and Chapel Lane Unitarian Chapel, and on Sunday evening the Lieutenant-Colonel, at his house in Halifax, and a number of the subscribers in Bradford and the neighbourhood, had the pleasure of hearing through their telephones the sermon preached at the chapel by the Rev. John Cuckson. The transmitter in the chapel was one of Crossley's patents, and was fixed and arranged on the book-rest of the pulpit by Mr. Hardy, Mr. Crossley's electrical assistant. It was some distance from the mouth of the speaker, but notwithstanding this, says the *Bradford Observer*, the utterances of the preacher were conveyed with wonderful distinctness to the hearers at various distances. The Telephone Company have also connected St. Paul's Church, Manningham, with their offices in a similar manner, and during both the services held in that church on Sunday persons living in Manningham, Baildon, Leeds, and other places, whose houses are connected by telephone with the Bradford office of the company, heard the sermons at their own homes as distinctly as if they had been at the church. The telephonic communication with Chapel Lane Chapel and St. Paul's Church is intended to be continued for the benefit of subscribers.

The Invention of the Telephone.—The following communication, dated July 24th, appears in the columns of an American contemporary, from the pen of Signor Antonio Meucci, of Clifton, S.I.:—"In order to substantiate Mr. Bell's priority in the invention of the telephone, under the date of March, 1876, which is so lengthily sustained in the communication of the 21st to all the leading papers, the examiner at the patent office, Washington, ought to be able to annihilate, with substantial facts and demonstrations, the three caveats which he, his predecessor, or the Commissioner of Patents, granted to me in the years 1871-1872-1873, through the patent solicitor, Thomas D. Stetson, for my application of same invention, and of which three copies are always in my possession, open to public inspection. When such evidence shall be brought forth and made public, I shall not hesitate to yield the priority of invention to

Mr. Bell, or any one else who might be entitled to it; but, until then, I shall not abandon my rights, and shall call myself, by valid documents, the first American citizen who has obtained from said patent office at Washington, a caveat which entitles me to the priority of invention of the great contended telephone."

The United Telephone Company.—A writer in *Truth* says :—"I hear that the London and Globe—the competing company—is laying down wires and establishing exchanges. As this latter company announces that it will take subscribers at £10 per annum, I hardly see how the United Telephone Company will be able to maintain its subscription at £20 per annum, and if it has to reduce it to one-half, it is not easy to see how it will be able to pay a dividend, not only on the real capital embarked in its undertaking, but upon the vast sums which have gone to fill the pockets of patentees and promoters. How often will it be necessary to tell the public that whenever a company pays the greater portion of its capital to promoters, either in cash or in shares, it is impossible that its shares can be worth even par? Patents very seldom hold water, and even where they do, in ninety-nine cases out of every hundred, science produces, within a very few years from the patent being worked, the same results without it. As a general rule, moreover, persons should take special care not to be entrapped into taking shares in the subsidiary companies which are brought out by a parent company. What some of the companies that have been engendered by the United Telephone Company, are, I have, in previous numbers, explained. Not one of them is, to my mind, worth the price of the paper of its shares. They will go the way of the subsidiary electric lighting companies."

The Gas Companies and the Electric Light.—Colonel William T. Makins, M.P., in presiding over the half-yearly general meeting of the proprietors of the Gas Light and Coke Company, held on Friday of last week, said that he looked upon electric lighting as in no sense a rival; he rather looked upon it as a colleague in the general lighting of the metropolis, and he did not think they had anything to fear from the progress that it was making. He believed that it would be very many years before it made much progress in house lighting, on the ground of the great difficulties which attended not only the storage of the light, but its distribution and uncertainty. Even assuming that it was to be the light of the future, he was convinced that gas would be the fuel of the future.

The Distribution of Electricity.—We are pleased to see that others besides ourselves have called attention to the unpractical scheme proposed by M. Gaulard for lighting the Suez Canal by electricity. Mr. Gisbert Kapp comes forward in our contemporary *Engineering* with a letter, from which we extract the following :—"As intermediate generating stations are not to be used the current must be supplied from the two termini of the canal; that is, each station will have to supply 50 miles of mains with current. If No. 0 B.W.B. copper wire (or an equivalent section of cable) be used the weight of copper required will be 160 tons. With 15 per cent. loss of potential through resistance of main leads the dynamos would have to work at a potential of 9,200 volts. Now, if we remember how the insulation of M. Marcel Deprez's machine in Munich (which worked at less than half this E.M.F.) was destroyed through a sudden interruption of the current, it is difficult to believe that any alternate current machine could safely work at the enormous potential of 9,200 volts. If, on the other hand, the pressure were fixed lower, the weight and cost of mains would have to be increased very much. Thus, for instance, at 2,000 volts the mains would weigh 3,200 tons, and reckoning them to cost £200 per ton for copper, fixing and insulation, would amount to the respectable sum of £640,000." We shall look forward to the "secondary generator" inventor's reply to this, considering that his estimate for the whole installation was under £100,000.

The International Fisheries Exhibition.—We are requested to state that the illumination of the Russian Court is by Messrs. Gérard and Co., Limited, which company is quite distinct from the Société Anonyme d'Electricité.

OFFICIAL RETURNS OF ELECTRIC COMPANIES.

Consolidated Telephone Construction and Maintenance Company, Limited.—The annual return of this company made up to the 14th June was filed on the 31st ult. The nominal capital is £300,000 in £1 shares; 224,850 shares have been taken up, and the full amount called thereon. The calls paid amount to £224,119 7s. 6d., leaving £730 12s. 6d. unpaid.—Registered Office, Telephone and Electrical Works, Farringdon Road, E.C.

London and Globe Telephone and Maintenance Company, Limited.—The annual return of this Company, made up to 18th ult., was filed on the 11th inst. The nominal capital is £600,000 in £1 shares; 140,007 shares have been taken up, and the full amount has been called thereon. The calls paid amount to £54,634 10s., and considered as paid on vendors' shares to £82,670, leaving £2,702 10s. unpaid.—Registered Offices, 31, Queen Victoria Street.

Electric Lighting, Supply, and Fitting Company, Limited.—The return of this company, made up to the 24th ult., was filed on the 11th inst. The nominal capital is £20,000 in £10 shares; 607 shares have been allotted, including 125 (fully paid) issued to the vendor. The full amount has been called up, the total calls paid (including vendors' shares) amounting to £5,788, leaving £282 unpaid.—Registered Office, 28, York Street, Westminster.

CITY NOTES, REPORTS, MEETINGS, &c.

Pilsen, Joel, and General Electric Light Company, Limited.

THE report of the directors, to be presented to the shareholders at the ordinary annual general meeting to be held on Wednesday, the 22nd day of August, 1883, states that in presenting the accompanying balance-sheet and statement of expenditure and receipts up to the 30th June, 1883, the directors would point out that, although the results of the working of the company up to the present time are not such as they could have wished, they will be found to be by no means discouraging.

It must be borne in mind, in examining this account, that, owing to the time occupied in fitting up the factory, the whole cost of thirteen months' expenses has been charged against the results of little more than six months' work, and that a large portion of the operations of the factory has been devoted to experiments with a view to improvements and economy in the construction of the several forms of the company's apparatus. The directors, therefore, do not consider that these results furnish any guide as to the future operations of the company, or present any reasonable discouragement to the shareholders; more particularly as the stock on hand, which is valued at cost price, may be expected to produce within a short period of improving trade in electric apparatus—of which the signs are already visible—sufficient profits to wipe off a large portion of the debit balance.

Before the directors had overcome the delays and difficulties attendant upon the installation of their works, and the manufacture of a supply of lamps and dynamos, the winter season had passed, the demand for electric lighting had almost ceased; and, consequently, after little more than four months of active production, the directors deemed it prudent to husband their resources, and to reduce the manufacturing expenditure to a minimum, pending a revival of the trade.

The action of Parliament has greatly contributed to check the demand for electric lighting, to suspend the action of all municipal bodies, and to encourage the public generally to look for more advantageous terms by waiting. During last year the discussion and passing of the Electric Lighting Act, and during this year the discussion and successive delays in the several stages of the Provisional Orders, have in fact nearly suspended the operations of all the electric lighting companies. The passage, however, by Parliament of a large number of Provisional Orders, which is now almost assured, will doubtless give an important impetus to electric lighting, in which this company may look forward to having a full share.

Of the three Provisional Orders for areas in London for which the directors originally applied, one, viz., that for a portion of

Holborn and New Oxford Street, passed the House of Commons without opposition, and will, beyond doubt, receive the Royal assent before the end of the Session. The local authorities controlling the other two areas (one in connection with the company's factories in the parish of St. Pancras, and the other in the City of London), having decided to apply for Provisional Orders for themselves, and having expressed their willingness to arrange with this company for carrying out the work in a portion at least of the contemplated areas, the directors decided not to proceed with their applications.

The directors are arranging with the Corporation of an important provincial city to light its principal streets. They are in negotiation for several important public contracts, and have orders in immediate prospect for arc and incandescent lamps, which will, they anticipate, speedily bring their factories into activity. Arrangements have been made with an influential company for the introduction of this company's lamps into the several Australian colonies, and the directors are at present in negotiation for the sale of concessions in that part of the world. They continue to view the colonial patents as an important asset of the company.

The directors have employed the slack season of manufacture in improving the old forms, and in working out new forms of their manufactures. Their present forms of Pilsen arc lamps and dynamo machines exhibit much greater efficiency than the original models of foreign make. They have also been engaged, and succeded in completing a single coil arc lamp, which can be sold at a reduced price, and will supply a desideratum in factories and places where their cheapness will be a recommendation. They have also succeeded, after patient and prolonged trials and experiments, in perfecting the Gatehouse incandescent lamp, which, as the prospectus announced, was not complete when the company took over the patents; and they believe that this lamp is now second to none in efficiency. A series of tests and trials made between it and the other principal forms of incandescent lamps, has shown the Gatehouse to be the most economically worked of all, and the directors count upon its proving a valuable source of profit to the company. The dynamos manufactured by the company have also been adapted to run incandescent lamps.

The shareholders are doubtless generally aware of the two attempts which have lately been made to injure the credit of the company, and to force it into liquidation. The circular of Messrs. J. G. Osborne and Co. collapsed with the repudiation of its author by two out of the four shareholders of whose names he had made use; and a petition addressed to the High Court of Justice to wind up the company, which was presented by three shareholders owning 150 shares (one of whom was named in Messrs. Osborne's circular), and which was opposed by the holders of 20,105 shares, was dismissed with costs, no attempt being made by the petitioners to justify their action. The directors refrain from commenting upon these proceedings, but they congratulate the shareholders upon the result.

In order to meet the requirements of the business, and to complete the partly manufactured stock, a call of 10s. per share has now become necessary, notice of which is herewith sent. The directors do not anticipate having to make another call, except for the purpose of carrying out Provisional Orders, or other works requiring a heavy outlay of capital, and the shareholders may be assured that the directors, who hold a very large stake in the company, have no desire or intention of carrying on the business except with a reasonable prospect of its becoming profitable. They have confidence in the extensive adoption of electric lighting in an early future; they have faith in the doctrine of the survival of the fittest; and they believe that this company contains the surest elements of future success in the possession of the best arc lamp in the market, and of semi-incandescent and incandescent lamps equal to any.

The directors have conducted the business of the company, and maintained its character during a period of great depression in electric lighting, and although the results of the first year's operations have been as disappointing to themselves as to the shareholders, they believe that they have laid the foundation of a profitable business, and they look with confidence to the shareholders for their support and encouragement in their efforts to establish and carry it on to a successful issue.

The auditors to the company, Messrs. Broom, Hays, and Akers, retire, but, being eligible, offer themselves for re-election.

The statement of expenditure and receipts from the incorporation of the company (May, 1882) to June 30, 1883, shows that the former comprises the following items :—Stock purchased, materials, wages, manufacturing charges and expenses, working expenses of installations, £14,967 8s. 3d.; general expenses (including directors' fees, £1,163 0s. 3d., and salaries, and accountant's charges, and proportion of managing directors' salary, £1,728 18s. 6d.), £4,884 16s. 3d.; depreciation of plant and machinery, £988 5s. 11d., and depreciation of furniture, £53 19s. 9d., together presenting a total of £20,894 10s. 2d. on the debit side. The credit side exhibits a total of £15,739 7s. 3d., made up as follows :—By sales of lamps, dynamo-machines, &c., and rents from installations, £3,112 17s. 1d.; miscellaneous receipts (interest, discounts, transfer fees, shareholders' lists, &c.), £1,097 13s. 5d.; stock on hand at factory, June 30, 1883, £11,528 16s. 9d. Thus it will be seen there has been an excess of £5,155 2s. 11d. for manufacturing, working, and general expenses above the total amount to the credit of the 13 months' working. The balance-sheet of the company may be thus stated :—The capital stands at £115,925, and sundry creditors, £1,577 2s. 7d.; total, £117,502 2s. 7d. The assets *and expenditure* are thus exhibited :—Cash at banker's, £1,160 10s. 1d.; sundry debtors, £1,296 16s. 8d.; stock and stores on hand (materials, £2,511 6s. 7d., manufactured stock, £9,213 5s. 1d.; ditto in progress at factory, £2,315 11s. 8d.), £14,040 3s. 4d.; stock and plant at out-stations and on loan (less depreciation), £4,090 11s. 4d.; plant, machinery, and tools at factory (less depreciation), £5,916 13s. 10d.; furniture at factory and head office (less depreciation), £485 17s. 9d.; goodwill and patent rights (comprising amount paid and due to vendors—cash, £15,000, and fully-paid shares, £60,000—stamp duty on assignment £375, patent fees paid by company £615 18s.), £75,990 18s. 0d.; parliamentary and legal expenses of applications for provisional orders, £749 7s. 9d.; expenses of adapting factory to company's business, £940 2s. 9d.; expenses of experimenting and perfecting lamps and dynamo-machines, making patterns, &c., &c., £5,690 10s. 5d.; expenses of exhibition and free installations, £1,010 12s. 0d.; advertising, pamphlets and circulars, and expenses of issuing same, £974 15s. 9d.; balance of manufacturing cost, &c., over receipts, £5,155 2s. 11d.; total, £117,502 2s. 7d.

The second ordinary general meeting of this company will be held at Cannon Street Hotel on Wednesday, the 22nd August.

The Cuba Submarine Telegraph Company (Limited).

THE twenty-fourth ordinary general meeting was held at the company's offices, 61, Old Broad Street, E.C., on Wednesday, Mr. Joaquin de Mancha, the Chairman of the company presiding.

The Secretary, Mr. J. Scott, having read the notice convening the meeting,

The directors' report, which we published in our last issue, was taken as read.

The Chairman said, in introducing to the notice of the shareholders the report and balance-sheet for the half-year ended 30th June last, there were only a few words he had to say; he had principally to congratulate them, and also the directors, upon the very favourable and sound position of the company. (Hear, hear.) They would see from the accounts that their expenses were very much the same as before, and had it not been that about £600 was spent in repairing the cables they would have been the same almost to the very figure. Their proposed mode of distribution, they would gather from the report, was to pay the usual 10 per cent. upon the preference shares and to declare a dividend of 9 per cent., free of income tax, upon the ordinary shares; and when a resolution to that effect was submitted, he thought it could but be received by congratulations. (Hear, hear.) He only hoped that they should continue gradually and slowly increasing their dividend; but even if it were to remain at 9 per cent. they should all have occasion to congratulate themselves. (Hear, hear.) He moved that the report and accounts be received and adopted.

Mr. A. F. Low seconded.

Mr. Griffiths said he was sure the shareholders could but endorse the observations made by the chairman as to the prosperity of the company. He had been looking at the articles of the company, and he found to his surprise that they were unable to reduce the number of their directors without calling an extraordinary general meeting. They had had the misfortune to lose Mr. Hughes, who had been their chairman and one of their directors, and as a matter of fact the number of their directors had been reduced from five to four. It seemed to him that it was illegal that their number should be so reduced, and that according to the terms of the articles the directors ought to have filled the vacancy, or if they did not the meeting ought to have done so. He was aware an objection might be taken to that to the effect that one of the articles said that the number should not be less than four or more than nine, and it might be argued that Article 82, in referring to a reduction, referred to a reduction from four to three or under, but legally that was not so, because no article could be altered unless by two special meetings. Article 82, therefore, as a matter of fact, required that a reduction from five to four should have been effected by an extraordinary meeting. That had not been so effected, and the consequence was that the number of their directors was one less than it ought to be. He threw out that suggestion merely for the consideration of their directors. As to the report, he was sure they all considered themselves fortunate that their business had been so good as to justify so large a dividend. In reference to the breakage of one of their cables by a ship, he maintained that if such a thing were to take place within three miles of the British coast, the owner of the ship would be responsible for the results of the negligence of the captain or crew, and would have to make compensation for the amount of damage done. It was possible, of course, that there was no blame attachable to the captain and crew of the ship which broke their cable, but if negligence could be proved they had a right to compensation. Possibly it might be wise on their part to ascertain if there had been negligence, and if so, if a strong letter from their solicitors would not result in their obtaining compensation. He should rejoice in anything that should tend to raise their dividend and put them in a more sound and prosperous state—not that at present they were not in a sound and prosperous condition, but if their stock continued to pay an increased dividend—if the dividend increased from 10 to 11 or 12 per cent.—he thought the good time might be coming when the preference shareholders would consider it wise to throw in their lot with the ordinary shareholders, and share with them the general prosperity attending the company.

Mr. Prust pointed out the sum of £106 7s. 7d. as being placed to the credit side of the account in respect of office furniture, and said it would be for the dignity of the company that such a paltry item should be wiped out. With regard to the directors, he should like to know if an increased number meant an increased expenditure. The salaries of the directors now amounted to £900 a year. Would an addition to their number mean an increase in that amount?

The Chairman said, in answer to Mr. Griffiths, that one of the directors retired, and that the articles said: "The number of the directors of the company shall not be more than nine or less than four;" therefore, as there were now four directors, he thought they were strictly within the terms of the articles.

Mr. Griffiths: That is so, taking that article alone, but look at article 82.

The Chairman (reading): "The company may from time to time, in extraordidary general meeting, increase or reduce the number of directors," but the directors had done nothing of that kind.

Mr. Griffiths: There were five of you.

The Chairman pointed out that the reduction of their number to four was not an act of their own. There were now four of them, and they did not think it prudent at present to increase their number. In reply to Mr. Purst, an increase in the number of directors meant an increase in expenditure in the shape of salaries. The injury to their cable was a small matter. They did endeavour to make the captain of the ship responsible, but their engineer informed them that it had been quite an accident, that there had been no negligence. As to the office furniture item, they owed the insertion of it in their accounts to their worthy auditor. They did endeavour to strike it out, but their auditor did not think it prudent to do so. In another company he (the chairman) was connected with, they wished to strike out of the accounts a similar item, and it was stated that they could not do so. It was an asset of the company, and it ought to appear in their books.

Mr. Purst: I do not like the 7s. 7d. Who can value furniture to a penny?

The Chairman: You do not care for the shillings and pence, only the pounds? (Laughter.) We may knock off the shillings and pence next time?

The Solicitor, Mr. Curtis Haywood, having been appealed to, upheld the construction put upon the articles of association in reference to the question of the number of directors raised by Mr. Griffiths.

Mr. Griffiths, however, still held that his was the proper construction.

The report and accounts were then unanimously adopted.

The Chairman next moved "That a dividend at the rate of 9 per cent., free of income-tax on the ordinary shares, and 10 per cent. on the preference shares be declared."

Mr. Low seconded.

In reply to Mr. Purst,

The Solicitor said various schemes had been put forward, so that the company might invest their reserve fund in the purchase of their preference shares. There were a great many difficulties about such schemes, but he might say, with absolute certainty, there was not the slightest doubt that the company could not go on the Stock Exchange and buy up their own shares, and there were no means of altering the articles of association to obtain such power. There had been a decision that a company might negotiate for the surrender of its shares, and the same result might thus be obtained, but it would be cumbrous and would not answer the purpose unless everybody agreed. The company might negotiate with separate shareholders to obtain from them their preference shares either by issuing to them a new stock or by paying them cash, but it would be of very little advantage to the company their buying up in that way an isolated number of shares. The directors had considered the point, and they did not at present see any particular advantage to be gained by carrying it out.

The resolution was adopted.

Mr. Joaquin de Mancha, the retiring director, was re-elected, and Mr. Greenwood was re-appointed auditor for the ensuing year at a salary of twenty guineas.

A vote of thanks to the Chairman and directors closed the meeting.

The Direct Spanish Telegraph Company, Limited.—The manager of this company states that arrangements have been made by which telegrams for Bilbao, Madrid, and other places in Spain can, during the present interruption of their Bilbao cable, be promptly forwarded by the Eastern Telegraph Company's route. Telegrams may be handed in at this company's station, 1, Leadenhall Street, London, or at the Eastern Company's stations. If handed in at postal telegraph offices the telegrams should be either written on the Eastern Company's forms or directed "*viâ* Eastern."

The West Coast of America Telegraph Company, Limited.—This company notifies a reduction of tariff from Great Britain, *viâ* Galveston (United States), to Valparaiso and all stations in Chili to 12s. 8d. per word.

The Eastern Telegraph Company, Limited.—The directors invite subscriptions for the unallotted balance of their issue of £500,000 Four per Cent. Mortgage Debenture Stock, of which the larger portion has been subscribed. They also notify that the rate to Valparaiso and other places in Chili has been reduced to 12s. 8d. per word.

LATEST QUOTATIONS.

Authorised Issue.	Share.	Name.	Paid.	Closing Quotatns, Aug. 15.	Business Done.
		ELECTRIC LIGHT.			
40,000	10	Anglo-American Brush Co.	7	2½- 3	
		Do. Do.	10	5½- 6½	
30,000	5	Australasian E. L., Power & Storage Co.	3	½- ¾	
24,900	10	British Insulite Co., Ld., "A" Shares..	5	1½- 2½	
30,000	5	Brush Elec. Lt. & Power Co. (Scotland)	2½	½- ¾	
25,000	5	Gt. Western Electric Light & Power Co.	2½	¼- ½	
24,980	5	Hammond Elec. Lt, & Power Sply. Co.	2½	½- 1	1-1/16-3/16-0 15/16 7/8-13/16-7/8
40,000	5	Indian & Ori. Electl. Storage Wks. Co.	2	..	
172,500	1	Maxim-Weston Elec. Lt. & Power Co. ..	1	1/16- 3/16	
..	..	Metrop. Brush Electric Lt. & Power Co.	3	..	
40,000	5	Pilsen-Joel & Gen. Elec. Lt. Co.	2	..	
..	..	S. African Brush Elec. Lt. & Power Co.	2½	..	
100,000	5	Swan United Electric Light Co., Ld.	2½	1½- 2½	
		TELEGRAPHS.			
2,116,400*l*.	Stk.	Anglo-American, Limited	100	48 - 49	48-7¾
2,441,800*l*	Stk.	Do. Pref. } Def. receiving no div. until	100	79 - 80	80-79.
2,441,800*l*	Stk.	Do. Def. } 6 p. c. paid to Pref.	100	17½- 18	17¾
130,000	10	Brazilian Submarine, Limited	10	11¾- 12	
16,000	10	Cuba, Limited	10	11 - 11½	11¼
6,000	10	Do. 10 per cent. Preference ..	10	17½- 18½	
13,000	10	Direct Spanish, Limited	9	5 - 5½	
6,000	10	Do. 10 per cent. Preference ..	10	15¾- 16¼	
65,000	20	Direct United States Cable, Ld., 1877 ..	20	12½- 12¾	12 11/16-¾
100,000*l*.	100	Do. 6 per cent. Deb., repayable 1884	100	100 -103	
380,000	10	Eastern, Limited	10	10⅝- 10⅞	10¾-13/16-¾
70,000	10	Do. 6 per cent. Preference............	10	12½- 13	
232,000*l*.	100	Do. 6 do. Debs., repayable Oct. 1883	100	100-102	
200,000*l*.	100	Do. 5 do. do. Aug. 1887	100	100-103	
200,000*l*.	100	Do. 5 do. do. Aug. 1899	100	103-107	
199,750	10	Eastern Exten., Australasia & China, L.	10	11¼-11½	11⅜-⅝
320,000	100	Do. 6 p. c. Debs., repayable Feb. 1891	100	106- 109	
500,000	100	Do. 5 p. c. (Aus. Gov. Sub.) Deb. 1900	100	102- 106	
140,000	100	Do. do. reg., repayable 1900..	100	102- 106	
100,000*l*.	100	Do. 5 per cent. Debenture, 1890	100	102- 105	
254,300*l*.	100	{ Eastern & South African, Ld., 5 p. c. } { Mort. Deb. Rg. redeemable 1 Jan. 1900 }	100	102- 105	
345,700*l*.	100	Do. do. do. To Bearer..	100	101- 104	
22,050	10	German Union Telegraph & Trust, Ld.	10	9¾- 10¼	
163,390	10	Globe Telegraph & Trust, Ld.	10	7¼- 7½	7⅜. xd.
163,209	10	Do. 6 per cent. Preference	10	12⅝- 12⅞	12 11/16-13/16xd.
125,000	10	Great Northern..........................	10	12⅝- 12⅞	
100,000*l*.	100	Do. 5 per cent. Debentures ..	100	100 -102	100½
300,000	100	Do. 5 per cent. Debentures ..	100	101 -104	
31,200	10	India-Rubber, Gutta-Percha, & Tel. Wks.	10	28½- 29½	xd.
100,000	100	Do. 6 per cent. Debs., 1886	100	103-106	
17,000	25	Indo-European, Limited	25	31½- 32½	
38,148	10	London Platino-Brazilian, Limited	10	3½- 4	
12,000	10	Mediterranean Extension, Limited	10	1½- 2	
8,200	10	Do. 8 per cent. Preference	10	2 - 4	
9,000	8	Reuter's, Limited	8	9½- 10	
280,000	Stk.	Submarine	100	230 -240	xd.
58,225	1	Do. Scrip	1	2 - 2¼	
4,200	Cert.	Submarine Cables Trust	100	103 -107	
37,350	12	Telegraph Construction and Mainten.	12	33 - 34	33¾
150,000	100	Do. 6 per cent. Bonds, 1884 ..	100	98 -101	
186,750	5	Do. 2nd Bonus Trust Cert. ..	2½	1⅝- 1⅞	
30,000	10	West Coast of America, Limited	10	4¾- 5¼	
150,000	100	Do. 8 per cent. Debs.	100	105 -108	
69,910	20	Western and Brazilian, Limited	15	5⅞- 6⅛	
		Do. Preferred	7½	4¾- 5¼	
		Do. Deferred..................	7½	1 - 1¼	
200,000*l*.	100	Do. 6 p. c.. Debs. "A" 1910 ..	100	102 -106	
2,500	100	Do. 6 p. c. Mort. Deb. B. '80, red. Feb. 1910	100	95 -100	
1,500	$1,000	Western Union 7 p. c. 1 Mort. (Bg.) Bds.	$1,000	122 -124	
1,030,000*l*.	100	Do. 6 per cent. Sterling Bonds	100	103 -106	
88,321	10	West India and Panama, Limited	10	⅞- 1⅛	
34,563	10	Do. 6 per cent. 1st Preference	10	6¼- 6¾	
4,669	10	Do. 6 do. 2nd do. ..	10	5 - 5½	
		TELEPHONES.			
154,165	1	Con. Tele. & Mainten., L., Nos. to 154,165	1	⅜- ⅝	
200,000	1	Oriental Tele. Co., Nos. 80.001 to 300,000	½	¼- ½	⅜
100,000	5	United Telephone Co.	5	8 - 8½	

TRAFFIC RECEIPTS.

The Brazilian and Submarine Telegraph Company, Limited. The receipts for the weeks ended the 27th July and the 3rd August amounted respectively to £2,720 and £2,896.

The West India and Panama Telegraph Company, Limited. The estimated receipts for the half month ended the 31st July are £2,723, as compared with £2,365 in the corresponding period of 1882.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending July 27th last were £1,691, after deducting the fifth of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited. Those for the week ending August 3rd were £1,705.

NEW PATENTS—1883.

3779. "Regulation of the movement of the carbons or electrodes in electric lamps." E. G. BREWER (Communicated by La Société Anonyme des Ateliers de Construction Mecaniques et d'Appareils Electriques). Dated August 2.

3782. "Transmitters for telephones." T. M. MORRISS. Dated August 2.

3815. "Supports for telephone wires." J. C. MEWBURN (Communicated by O. N. André). Dated August 4.

3827. "Electric lamps or lighting apparatus." W. R. LAKE (Communicated by F. Girard et Cie). Dated August 4.

3839. "Compounds for electric wire insulators, pipes, and other articles." W. P. THOMPSON (Communicated by J. F. Martin). Dated August 7.

3842. "Apparatus for circuit closers and connections for electric alarms." H. W. FERRIS. Dated August 7.

3846. "A floating electric light depôt for lighting vessels that may be stationary or under way, and for other purposes, parts of which being applicable on land for lighting vessels or other floating or movable bodies." A. L. FYFE, L. GOLDBERG. Dated August 7.

3847. "Electric signalling and fire extinguishing apparatus." W. R. LAKE (Communicated by S. Ziembinski, M. Szwambaum, and H. Stypulkowski). Dated August 7.

3873. "An improved process and apparatus for separating and treating metals and extracting them from ores, matts, or all other substances containing them by means of electrolysis, which invention is also applicable for other purposes." H. R. CASSEL. Dated August 9.

3877. "Treating alcoholic liquors with electricity to purify and impart to them the character of age." W. E. GEDGE (Communicated by A. C. Tichenor). *Complete.* Dated August 9.

3883. "Improvements in the construction of incandescent lamps, and in supports and electrical fittings to be used in connection therewith, which improvements are in part applicable to electrical lighting generally." T. T. SMITH. Dated August 10.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1882.

5769. "Electro magnets and electro dynamo machines." EDWARD GRIFFITH BREWER. Dated December 4. 4d. (A communication from abroad by Auguste Louis Bonnefils, of Paris, France.) This invention refers to the construction and employment of electro magnets of a spherical or spheroidal form, "a magnetic sphere," and in the application of these magnetic spheres or spheroids to the construction of ordinary induction machines combining them with other forms of known electro magnets, either as a magnetic fixed or movable sphere excited by ordinary electro magnets or as a hollow magnetic sphere exciting other kinds of bobbins placed inside the sphere or as a hollow magnetic sphere exciting another magnetic sphere. According to this invention the electro magnets are made with a spherical core of cast or other iron, according to circumstances, hollow or not, on which a wire or wires covered with some suitable insulating material is wound spirally always in the same direction starting from one side to the other. If an electric current is passed into the wire or into one of these wires this sphere becomes an electro magnetic sphere as an ordinary electro magnet having two poles, each situate opposite one end of the wire of the helix. *(Provisional only.)*

5870. "Increasing the efficiency of telephones." WILLIAM ROBERT LAKE. Dated December 8. 6d. (A communication from abroad by Amos Emerson Dolbear, of Somerville, Massachussets, United States of America.) This invention relates to telephonic apparatus, and is chiefly designed to increase the efficiency of the instrument invented by Professor Amos Emerson Dolbear, known as the electro static telephone, and described in the specification of former letters patent, dated March 29, A.D. 1881, No. 1395. Since the date of the said former letters patent it has been discovered that when one of the plates or terminals of the receiver is kept charged to a high potential by a "Holtz" machine or other generator or source of electricity, the mutual action and reaction between the two plates or discs of the said receiver, when the same is used telephonically, will be much greater, and the instrument will be much more efficient than heretofore. It is manifestly not impossible to effect this result by the use of a machine kept in continuous rotation, or by otherwise maintaining a continuous supply of electricity; it is, however, obvious that a method of working or using these instruments, which involves the continuous rotation of a machine, or the use of such a number of battery cells as is necessary to give the required potential for so charging the instrument, would be highly inconvenient if not impracticable. By this invention the inventor provides for charging the instrument, and keeping it charged, without this inconvenience. It is well known to electricians that shellac, gutta-percha, india-rubber, and other materials of like specific inductive capacity are highly advantageous for use as dielectrics in condensers, and that these substances possess the property of absorbing and retaining a static charge of electricity. The inventor avails himself of this property in such a manner that the receiver, when once charged, will remain in a highly efficient condition for many hours or even days without being recharged.

FIG.1.

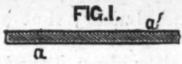


FIG.2.

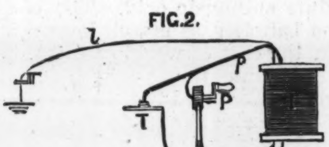


FIG.3.

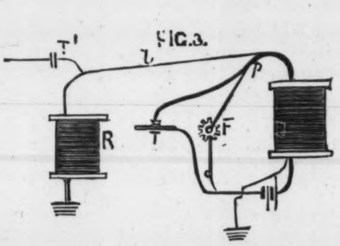


Fig. 1 shows, in transverse section, a portion of one of the plates drawn to an enlarged scale; *a* represents the metallic plate, and a^1 the coating of shellac or similar dielectric. Figs. 2 and 3 are diagrams illustrating the practice of the said invention. Before the date of the present invention it was thought necessary to connect the metal plate with some generator of continuous high electromotive force, such as a battery of many cells, or a Holtz machine kept in rotation. This not only kept the metal plate charged, but also necessarily charged the line with which the said metal plate was in electric connection, and, while efficient as to the desired result, was objectionable for other reasons. In fig. 2 the plate is connected with a line, *l*, of which the secondary coil of the inductorium, I, forms a part. In the primary circuit, *p*, of this inductorium there is a circuit-breaker or interrupter, P, by the operation of which the circuit can be rapidly made and broken, thereby inducing momentary electromotive force in the secondary coil of the inductorium, I, and the line, *l*, and alternately charging and discharging the metal plate, *a*, so that the coating, a^1, soon becomes charged, and it will remain in this condition for a considerable time, in some cases for several days. In the practical use of this apparatus the person about to use the telephone first operates the circuit-breaker, P, for a few seconds, then talks to the transmitter, T, in the usual manner, and is heard at the receiver, T^1. In fig. 2 the line is an open circuit, and the plates form the terminals of such circuit; but this arrangement is not essential, for the line may be a closed circuit, provided a resistance be interposed, say as shown at R in fig. 3, to cause sufficient electric pressure or potential at that point in the line at which the plate of the receiver, T^1, is connected. The other plate of the receiver, T^1, in fig. 3 may be grounded or otherwise arranged as described in the above named specification. The construction of the receiver, T^1, is substantially the same as described in the said specification, except that the plates are coated with shellac or other dielectric as above specified; in practice the well known ferrotype iron is used in making these plates.

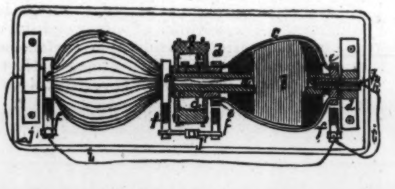
5887. "Voltaic batteries." LEO HARTMANN. Dated December 9, 2d. The inventor employs as the exciting liquid, caustic potash or caustic soda in solution, and for the positive electrode zinc, while for the negative electrode he employs either iron, copper, nickel, cobalt, silver or gold. By preference he uses silver or iron in the form of network alone or in combination with fragments, or of fragments alone, although network is preferable, or any body organic or inorganic also in the form of network coated with silver by the electrolytical process. He constructs the outer cell of a flat shape, like a shallow pan or a plate. Upon the bottom of this is placed the zinc, by preference in the form of strips, either coiled spirally or otherwise arranged so as to offer considerable surface. Upon the zinc is placed a porous diaphragm of earthenware, textile fabric, or other suitable material, so arranged as to entirely separate the lower part containing the zinc from the upper part containing the negative plate, and upon this diaphragm is placed the negative electrode, formed by preference of a network of silver or iron, or any other form may be used presenting considerable surface, and which is immersed in or merely damped by contact with the exciting liquid in which the zinc is immersed. *(Provisional only.)*

5977. "Galvanic batteries." JOHN RAPIEFF. Dated December 14, 4d. This invention relates to improved galvanic cells and to the construction of new cells for the same purpose, namely, for generating electric currents, and consists:—Firstly. In increasing the surface of electrodes made of carbon, which the inventor proposes to prepare from one or several comparatively thin sheets of carbonised and suitably treated organic substances or cellulose, perforated or not, grooved or not, and bent into zigzag, spiral, cylindrical, or other suitable forms. For the same purpose he uses as electrodes, not only single blocks of the carbon but a row or rows, group or groups, of comparatively thin pencils or rods of carbon, such as gas retort carbon, coke, or electric light carbon, or any other kind of carbon. For the same purpose, he employs carbonised fibrous substances, such as cotton, flax or hemp, or threads or strands twisted together, or separately, or tulle, tarletan, muslin, canvas, net, linen and other fibrous, woven, or textile materials. These materials may be used separately or combined with those above mentioned. Secondly. In new forms of improved cells. For one electrode the inventor takes lead, solid or perforated, bent or straight, grooved or not, in form of one or more sheets, rods, wires, webs, gauze, ribbons, &c., or formed into a vessel. He then takes peroxide or oxide of lead, barium, or their equivalent, separately or combined, or mixed with small pieces, residuums, or cuttings of lead, shot, powdered or granulated lead, or carbon or graphite, and place them around the above-mentioned electrode in a porous vessel, which may afterwards be closed or sealed, leaving, or not leaving, an aperture for the escape of the gas and the charging and discharging of the cell. This porous vessel he puts into another vessel of larger size into which is also put another electrode made of zinc, in form of rod, sheet, cylinder, pieces, &c.; or this larger vessel may itself be made of zinc. As active liquid for the charging of this cell he proposes to use a solution of the salts or hydrates or oxides of zinc, ammonia, potassium, sodium and other alkaline metals; or a solution of an acid, separately or together with the above-mentioned solution. Modifications of this arrangement are mentioned.

5899. "Apparatus for lighting, heating, and communicating by electricity, &c." PERCY RUSKIN ALLEN. Dated December 9th. 8d. This invention relates to lighting, heating and inter-communication in railway trains, and refers partially to the inventor's former patent, No. 2,215, of May 20, 1881.

5918. "Dynamo-electric machines." HENRY HARRIS LAKE. (A communication from abroad by Richard Henry Mather, of Windsor, Connecticut, United States of America, electrician.) Dated December 12th. 8d. This invention relates to dynamo-electric machines, and comprises novel features of construction. The improved machine has a field-magnet in two parts, arranged in the same general longitudinal line with the armature, located and adapted to be rotated between them. One of the peculiarities of this machine is the armature, the iron core of which is a flat disc, provided with tranverse grooves at regular intervals in its peripheries, to hold the coils of insulated wire. When three coils are used there are six of these transverse grooves. The magnetic axis of this disc is at right angles to the axis of rotation, that is to say, parallel with the plane of rotation. Magnetism seldom or never extends far beneath the surface of a mass of iron, especially when the iron is in motion; generally magnetism does not extend more than an inch beneath the surface, hence an armature, in order to be very effective, that is to say, in order to produce a current of high electromotive force with a short length of wire on the armature core, must have a considerable amount of surface as compared with the amount of metal contained in it; moreover, the shape of the armature must be such that the wire may be readily coiled upon it.

5961. "Dynamo or magneto-electric machines." GEORGE LEE ANDERS and JOHN BENJAMIN HENCK, jun. Dated December 13th. 6d. The improvements relate to machines for the production of electric currents by the rotation of a conductor in a magnetic field, and have for their chief object the construction of a machine which will produce a continuous and uniform electric current without reversing the magnetic polarity of any part, and therefore without the necessity of a commutator for reducing or converting alternating, or contrary, into continuous currents, as in previous machines, for the production of continuous currents. The invention is also designed to afford the further advantages of great simplicity of construction and low internal resistance. The inventors accomplish these results by employing a cylindrical or globular shell of non-magnetic metal, preferably copper, arranged to revolve about an axis coinciding with the magnetic axis of the permanent, or electro magnetic system, by which the field is maintained; this shell is so shaped and arranged as to cut the lines of force of the magnetic field as nearly as possible at right angles, and to allow of taking off the current at two or more points, so situated that the greatest possible number of magnetic lines of force will pass between the point or points constituting the positive terminal and the point or points constituting the negative terminal, such lines of force all passing in the same direction. In the form of the machine, shown in the fig., and embodying the above principles, they use a magnet consisting of a fixed hollow iron shaft, *a*, having a wire coil, *b*, about each of its ends; the outer surfaces of the coils are preferably shaped to coincide as nearly as practicable with an equipotential surface of the magnetic field. Each coil is surrounded by a copper shell, or cage, *c*, consisting of a number of strips or bars fixed at each end to a ring, *d*, the said ring being so fitted upon the shaft, *a*, that it can rotate about the said shaft. Rings, *e*, are fitted over the ends of the said strips, and brushes, *f*, f^1, are secured to the frame of the machine, and arranged to bear upon the said rings, *e*, and thus form contacts. The two contacts, *f*, at the opposite extremities of the machine, are used as positive terminals, while those, f^1, at the central part of the machine form the negative terminals, or *vice versa*, according to the direction of rotation. If preferred the two shells may be united at the centre of the machine, and only one contact made at that point. *g* is a driving pulley, which is firmly fixed to flanges, d^1, upon the rings, *d*, at the inner ends of the shells, *c*, by bolts or other suitable means; *h* is a brass tube fitted in the end of the shaft, *a*, and secured at h^1 in the frame of the machine for supporting the iron shaft, *a*, and to form a passage for the conducting wire, *i*. This wire is connected to the brushes, *f f*, whence it passes through the tube, *h*, and is wound around the two ends of the shaft, *a*, to form the coils. It is then connected to a binding post, *j*, to which one terminal of the external circuit is secured. The brushes, f^1, are in electrical connection with the binding post, j^1, to which the other terminal of the external circuit is secured.



TO CORRESPONDENTS.

No notice can be taken of anonymous communications. Whatever is intended for insertion must be authenticated by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

CORRESPONDENCE.

Technical Education.

As one who can speak from practical experience, I should like to make a remark or two on Mr. Handford's excellent article. I have found, when pursuing my studies (though they are not of an extensive character), that the simultaneous acquirement of two or three distinct branches of knowledge is not only no detriment to any of them, but a positive assistance. Often, when completely weary of ohms, volts, and such like, have I turned with feelings of relief to Spanish or French, and felt absolutely refreshed. I should earnestly recommend the perusal of Mr. Handford's paper to my fellow-students; but should also like to remark that, for a quiet mind-refresher, a game of chess, in my opinion, stands pre-eminent. Physical exercise, too, is a most important feature in the student's programme, the neglect of which has probably more to answer for than is generally comprehended.

Prize Medallist.

Primary Batteries v. Steam.

In a paper in your issue of the 11th, Dr. C. W. Siemens says that electricians formerly expected to get power from primary batteries to compete with steam, but that their expectation was futile, as it was grounded in ignorance of the laws of nature upon which electrical science is based. For as it takes from 15 to 20 tons of coal to produce one ton of zinc, and when it is produced, one pound of it, in combining with oxygen, only produces 2,340 units of heat, whereas one pound of coal produces 12,000. It therefore follows that zinc cannot compete economically with coal in the production of heat or electricity, which is very much the same thing, as they are interchangeable. This reasoning is evidently based upon the supposition (pretty generally entertained) that all the electricity generated in a primary battery is got from the consumption of zinc alone, and is in exact proportion to the amount consumed. There are certain facts that have come under my notice, in connection with Mr. Gray's, of Gateshead, battery that appear to controvert this supposition.

To make the matter clear, I will compare it with a Grove or Bunsen, in which the zinc is exposed to the action of dilute sulphuric acid. The consumption of zinc in these batteries, as is well known, is a considerable item in the cost of working them. With a large consumption of zinc they produce an electromotive force of from 1·888 to 1·964 volts only, but in Mr. Gray's battery the zinc is exposed to the weaker action of a saturated solution of common salt, and the consumption of zinc is only 300 grains for each cell in a battery of four cells during twelve hours, running a 2½ candle incandescent lamp with an electromotive force of from 2 to 2·4 volts. The porous, or inner cells of this battery, I may mention, were 6 × 2 in. cylinders, each containing three ounces of the exciting solution, and the carbon element, and short-circuited producing a current of 18 ampères, which shows its low resistance—viz., $\frac{3}{20}$ of an ohm.

The way in which Mr. Gray accounts for the high electromotive force and the large product of electricity with a low consumption of zinc, is that it is not wholly evolved in the combining of oxygen with zinc in the outer cell, but also in the combining of oxygen with hydrogen in the inner. If any one can explain this higher evolution of electricity with a lower consumption of zinc in the prevalent supposition that the whole of the electricity in a primary battery must be obtained from the consumption of zinc, and that it is dependent solely upon the quantity consumed, perhaps he will kindly do so.

H. W. Fawcus.

19, Denmark Street, Gateshead.
August 13th, 1883.

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